CASIO®

GETTING STARTED WITH THE CASIO GRAPHIC CALCULATOR

fx9750GII

CONTENTS


CASIO
fx-9750GII
Y1=(X+2)(X-1)(X-3)
X Y1
-3 -24
-2.5 -9.625
-2 0
-1.5 5.625
X=-1.5
Y=5.625
USB POWER GRAPHIC
Trace Zoom V-Window Sketch G-Solv G↔T
F1 F2 F3 F4 F5 F6
PRGM SET UP
SHIFT OPTN VARS MENU
A-LOCK QUIT
ALPHA EXIT
REPLAY
X,θ,T log ln sin cos tan
a b/c F↔D ( ) , →
CAPTURE CLIP PASTE INS OFF
7 8 9 DEL AC/ON
CATALOG
4 5 6 × ÷
List Mat
1 2 3 + −
SPACE Ans
0 • EXP (−) EXE

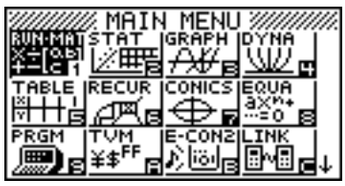
Congratulations on your recent purchase of the CASIO® FX9750GII.

The 14 Main Menu Icons

Select any mode from the **MAIN MENU** by using the arrow keys to highlight the **MODE** icon that you want or press any of the digits 1 ~ 9 or letters A ~ E.

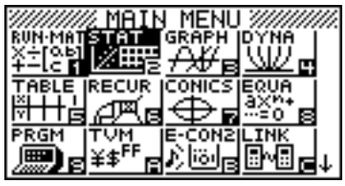
RUN–MAT

The scientific calculator with **OPTION** features.
To enter, and perform row/column operations on Matrices, up to dimensions of 8 x 8, basic calculations to complex number and calculus calculations, to name a few.



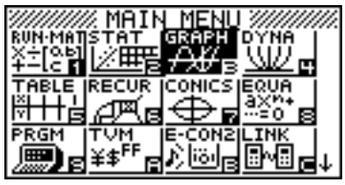
STAT

For statistical calculations and statistical graphs, with univariate or bivariate data. Statistical modelling using Binomial, Poisson and Normal distributions to name a few. To manipulate lists (this can also be done in the **STAT** mode) or change List Files.



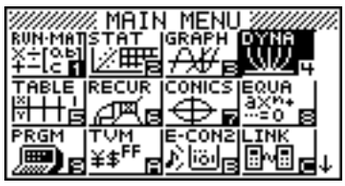
GRAPH

To graph and analyse functions and relations, parametric graphs and polar graphs. Storage of up to 20 different functions, with the ability to solve and differentiate numerically. Equations entered can be of the form “Y=” or “X=”.



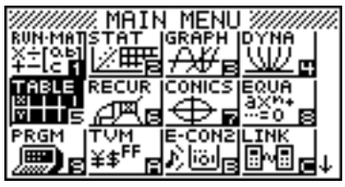
DYNA

To look at the effect of a changing constant or coefficient on the graph of a function. A great demonstration tool for dynamic and animating graphs.



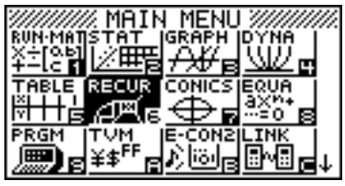
TABLE

Will produce a table of values for any function and its derivatives if required.



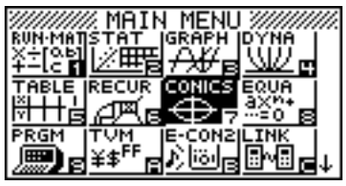
RECUR

To produce tables and graphs from, and analyse, recursive relations, such as arithmetic and geometric sequences and series.

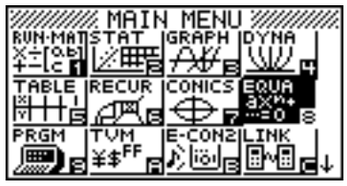


INTRODUCTION

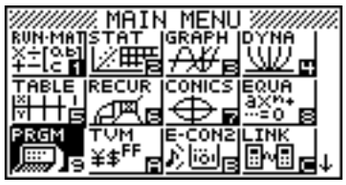
CONICS
To graph and analyse conics including circles, hyperbolas, ellipses and parabolas in rectangular, parametric or polar formats.



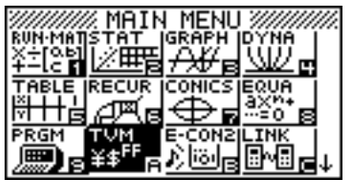
EQUA
Will solve simultaneous equations (up to 6 x 6) and polynomials (degree 2 ~ 6), displaying solutions in real and complex form. Also contains an equation solver to find the value of any pronumeral (letter) in an equation entered.



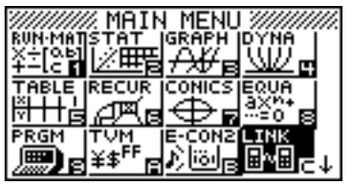
PRGM
Program mode. Use this mode to write and store programs, you can execute (run) the programs here also.



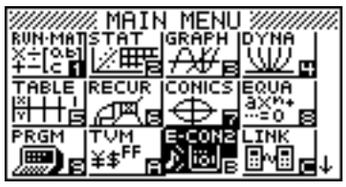
TVM
Time, Value of Money and other financial and economic calculations.



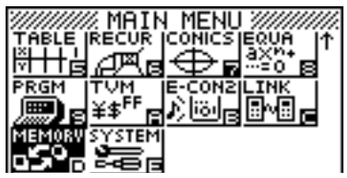
LINK
Allows the calculator to link to a PC or another CASIO calculators to transfer programs and data, via the USB or 3-pin. Connection can also be made to a data projector and settings.



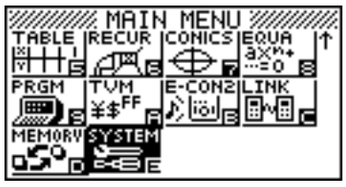
E-CON
Connection to data logger EA200 and Motion sensors and other data collection probes.



MEM
Memory. Shows memory usage and allows you to reset individual icon memory or the entire calculator. Note that resetting the calculator will delete stored data and programs. Contrast adjusts the contrast and grey scale balance.

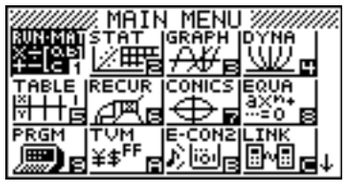


SYSTEM
System setting and operating version. Language setting for calculator display.



Switching on and off

In order to start your Casio FX9750GII, after you have placed the four AAA batteries into the battery compartment, do the following:

KEY	AC/ON	SHIFT AC/ON
RESULT		

Screen

This is called the **MAIN MENU** and can be accessed by:

KEY	MENU

What are the 'Icon' modes?

There are 14 different 'icons' that are accessible from the **MAIN MENU** by using the arrows to cover the particular icon that you want to be in, or each icon has a number or letter associated with it, for quick key entry.

The user can use either the number keys 1 - 9, or the letter keys A - E

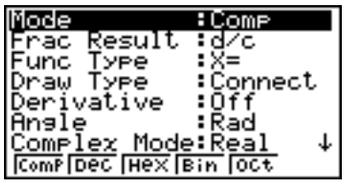
OR

use the replay arrows  ▲ ▶ ▼ ◀ to highlight the icon and then press 

In the RUN-MAT icon

Most of the calculator performances can be executed in this mode. The calculator has T.A.L (True Algebraic Logic) embedded into its functionality.

Setting up within each icon

KEY	SHIFT MENU
RESULT	 *Top Screen*  *Bottom Screen*

This screen display assists the user in setting up the calculator to the specifications that they require. By selecting the appropriate grey **[F1], [F2], [F3], [F4], [F5] or [F6]** keys you select the settings you require.

GETTING STARTED

Mode, Fraction result, Function Type, Draw Type, Derivative, Angle, Complex mode, Co-ordinate, Grid, Axis, Label, Display and Simplify are self-explanatory settings.

Returning to previous 'Menus' on the screens

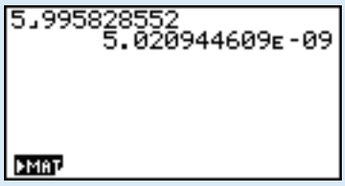
KEY	EXIT

Display

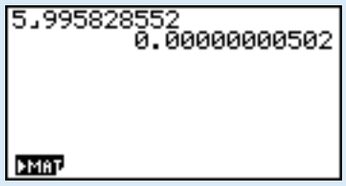
This mode determines the form in which answers obtained from calculations will be displayed.

Example

NORM 1



NORM 2



Editing entries

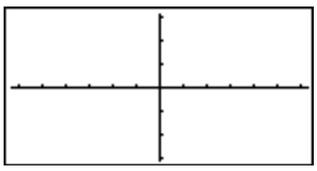
For editing any calculations, using the replay arrows ◀ ▶ changes can be made easily to text or numerical entries.

Editing can also be done by using the **[DEL]**ete and **[INS]**ert keys, move the cursor to where you want to do the editing and strike these keys to complete the editing.

KEY	DEL	SHIFT INS DEL
	Delete	*Insert*

Toggling between the TEXT and GRAPH screen G↔T

There are two screens that 'sit' on top or underneath each other, the **TEXT** and **GRAPH** window. By pressing **[SHIFT]** **[F6]** you can toggle between the two screens.

KEY	SHIFT G↔T F6		
RESULT			

Clear Screen

Clearing the Graphical Screen so that you don't superimpose graphs can be done either by:

Enter **V-Window** and alter the viewing screen domain and range values as desired.

KEY	SHIFT G↔T F6

OR

Enter Sketch.

KEY	SHIFT Sketch F4 *then* Trace F1 EXE

Basic activities in RUN-MAT icon

BEDMAS to reinforce the importance of the order of mathematical operations.

Example

Simplify 8 + 12 ÷ 4 - 2	*Result*
8 + 1 2 ÷ 4 - 2 *then* EXE	8+12÷4-2 9 ▶MAT

Example 2

Simplify (8 + 12) ÷ 4 – 2	*Result*
(8 + 1 2) ÷ 4 - 2 *then* EXE	(8+12)÷4-2 3 ▶MAT

Example 3

Simplify 8 + 12 ÷ (4 – 2)	*Result*
8 + 1 2 ÷ (4 - 2) *then* EXE	8+12÷(4-2) 14 ▶MAT

Example 4

Simplify (8 + 12) ÷ (4 – 2)	*Result*
(8 + 1 2) ÷ (4 - 2) *then* EXE	(8+12)÷(4-2) 10 ▶MAT

Basic activities in RUN-MAT icon cont.

Fractions, decimals and percentages

Fractions can be entered into calculations with the fraction key.

KEY	ab/c

Example

To add 3 1/7 and 2 3/5 together	*Result*
3 $a^b/_c$ *then* 1 $a^b/_c$ *then* 7	3.1.7 ▶MAT
+ 2 $a^b/_c$ *then* 3 $a^b/_c$ *then* 5 *then* EXE	3.1.7+2.3.5 201.35 ▶MAT

To convert to a mixed fraction

KEY	SHIFT F↔D

Example

Convert result of 3 1/7 and 2 3/5	*Result*
SHIFT F↔D	3.1.7+2.3.5 5.26.35 ▶MAT

To convert to a decimal

KEY	F↔D

Example

Convert result of 3 1/7 and 2 3/5	*Result*
F↔D	3.1.7+2.3.5 5.742857143 ▶MAT

OR

To enter a fraction without the fraction key

KEY	÷

Example

Enter 3/8 :	*Result*	
3 ÷ 8 *then* EXE *then* F↔D	3÷8 0.375 ▶MAT	3÷8 3.8 ▶MAT
	Decimal	*Fraction*

Fractions and decimals can be calculated together.

Example

Multiply $^{3}/_{16}$ by 2.8	*Result*	
3 $a^b/_c$ 1 6 x 2 . 8 *then* EXE	3⌟16×2.8 0.525 ▶MAT	3⌟16×2.8 21⌟40 ▶MAT
	Decimal	*Fraction*

Percentage key

The graphics calculator does not have a specific 'Percentage' key. Just remember that 48% is the same as $^{48}/_{100}$ or 0.48.

Example

Calculate 48% of $16.40	*Result*
4 8 ÷ 1 0 0 x 1 6 . 4 *then* EXE	48÷100×16.4 7.872 ▶MAT
4 8 $a^b/_c$ 1 0 0 x 1 6 . 4 *then* EXE	48⌟100×16.4 7.872 ▶MAT

Powers and roots

KEY	SHIFT x^2

Example

Evaluate √25	*Result*
SHIFT x^2 2 5 *then* EXE	√25 5 ▶MAT

KEY	SHIFT (

Example 2

Evaluate $\sqrt[3]{27}$	*Result*
SHIFT (2 7 *then* EXE	∛27 3 ▶MAT

KEY	^

Example 3

Evaluate 2^5	*Result*
2 ^ 5 *then* EXE	2^5 32 ▶MAT

Basic activities in RUN-MAT icon cont.

Powers and roots cont.

KEY	SHIFT ^

Example

Evaluate $\sqrt[4]{625}$	*Result*
4 SHIFT ^ 6 2 5 then EXE	4*√625 5 ▶MAT

Algebraic Substitution

Enter the calculation by replacing each letter in the formula with its corresponding number.

Example

Calculate V = (A – 4)(B + 4) where A = 30.34 and B = 47.5	*Result*
(3 0 . 3 4 - 4) (4 7 . 5 + 4) then EXE	(30.34-4)(47.5+4) 1356.51 ▶MAT

When you have a number of algebraic substitutions to do then it would be easier to use the memory aspect of the calculator keys. There are 28 different storage places i.e. A ~ Z, θ and Γ. These are accessed via the **[ALPHA]** key then the associated key required.

KEY	ALPHA →

You 'assign' a value to the letters you want to use with the **[→]** button, then enter the algebraic expression into the calculator. Press **[EXE]** for the calculator to store the value in the memory.

Example

Calculate V = (A – 4)(B + 4) where A = 30.34 and B = 47.5	*Result*
3 0 . 3 4 → A then EXE 4 7 . 5 → B then EXE	30.34→A 30.34 47.5→B 47.5 ▶MAT
(A - 4) (B + 4) then EXE	30.34→A 30.34 47.5→B 47.5 (A-4)(B+4) 1356.51 ▶MAT

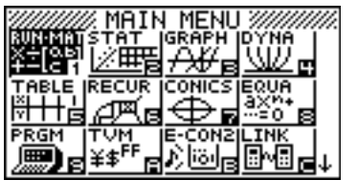
Notes:

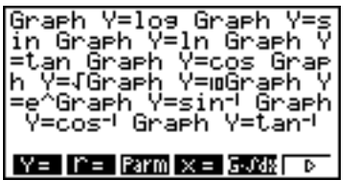
GRAPH DRAWING

Drawing graphs is easy using the FX9750GII! They can be drawn in the **RUN-MAT** or **GRAPH** icons.

RUN-MAT icon

The functions (and more) listed below (and there are many more) have been 'installed' into the calculator for quick graphing. Each has its own unique pre-set domain and range values.

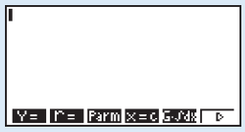


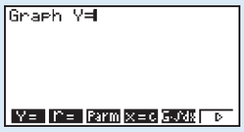
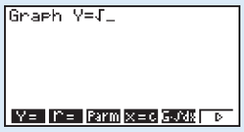
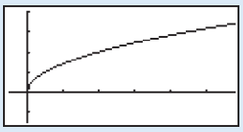


KEY	SHIFT	F4	F5	F1	x^2

Example

Draw the graph of y = √ x

Key	AC/ON	SHIFT	F4	F5
Result				

Key	F1	SHIFT x^2	EXE
Result			

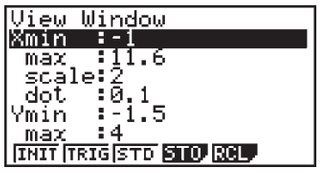
Note: *There is no need to include the 'x'.*

The graph as it appears on the screen gives a clear idea of the shape but no indication of the values on the horizontal or vertical axis, except for ------+------ marks on the axes.

To find information on a graph's scale

View the domain and range values in **V-Window**.

This display tells the user that on the x-axis the scale is 2, and hence the marks on the x-axis are 0, 2, 4, 6, 8, 10. The y-axis has a scale of 1 and hence the marks on the y-axis are -1, 0, 1, 2, 3, 4.

KEY	SHIFT F3
RESULT	

Clearing the screen [Cls]

KEY	SHIFT F4 F1 EXE

After each graph has been drawn then **[SHIFT] [F4] [F1]** key followed by **[EXE]** is necessary to clear the previously drawn graph, otherwise the graphs will be superimposed.

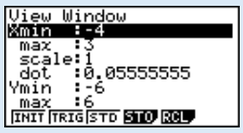
Note: *Numerous graphs can be superimposed, allowing linear programming.*
Separating each graph equation with a ' : ' (colon) provides functions that can be traced and if necessary zoomed in on to find vertices that define the feasible region (points of intersections) etc.

Graphs that need to have the Domain and Range edited

Changing the values in the **V-Window** is easily executed. Single editing or pre-set **[F1] [F2] [F3]**.

KEY	SHIFT F3	RESULT	

Example

For the graph y = (x - 1)/(x + 2) a suitable range could be -4 < x < 3 and -6 < y < 6	*Result*
[-] [4] [EXE], [3] [EXE], [1] [EXE], [▼], [-] [6] [EXE], [6] [EXE], [1] [EXE] *then* [EXIT]	

Varying the **Domain** and **Range** is a necessary skill when developing the connections between the graphical, symbolic and numerical aspects of equations.

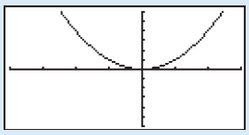
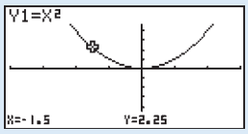
Tracing functions

KEY	F1

The interpretation of the graphed functions is supplemented by the use of the Trace key. The (x, y) values of points on the curve are displayed underneath the drawn graph.

Example

For the graph y = x^2, (i.e. y = x^2) a suitable range could be -4 < x < 3 and -6 < y < 6.

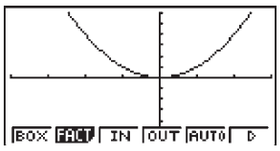
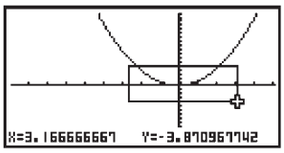
Key	[SHIFT] [F1]	[◀] [▶]
Result		

Using the left and right arrows the user can trace over the graph and give accurate x and y values of many points on the curve.

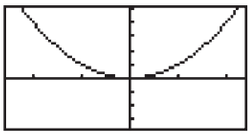
GRAPH DRAWING

Zooming in and out

The ‘zooming’ is easily initiated when parts of a graph need to be seen in more detail - ‘roots’ to the equation, maximum or minimum points or other aspects under investigation.

KEY	SHIFT F2	F1
RESULT		

By choosing **BOX [F1]** you can decide what ‘new’ domain and range values will be used for the **V-Window**. To make the **BOX** use the arrows to determine where a vertex of the **BOX** is to be then **[EXE]**. Use the arrows again to complete the **BOX**. When you are satisfied with its position, press **[EXE]** and the new view window will be drawn.



Note: *The different ‘menu bars’ as listed below.*

FACT	Scale factor for V-Window for IN	**ORIG**	The original graph drawn before zooming in or out
IN	The calculator will zoom in on centre of screen	**SQR**	
OUT	The calculator will zoom out on centre of screen	**RND**	
AUTO	The calculator will calculate what it thinks best for the graph to be drawn	**INTG**	
▶	Next selection window	**PRE**	

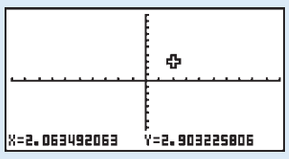
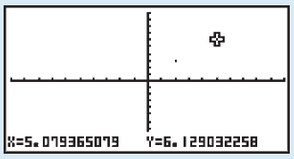
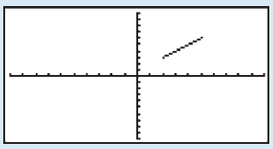
Plotting points

Plotting points from tables for example is easy to do, as is drawing a line between these points.

KEY	SHIFT F4 F6 F1 F1

Example

Plot the points 2, 3 & 5, 6

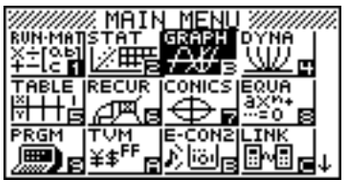
Key	SHIFT F4 F6 F1 F1 2 , 3 EXE EXE	F6 EXE F1 5 , 6 EXE	EXE SHIFT F6 EXIT F2 F1 EXE
Result			

Note:

*1. The **V-window** will determine how ‘close’ the point being plotted is. The dimensions of the screen are 123 pixels wide and 63 pixels deep. This is determined by the **INIT**ial settings in the **V-window**. More about the **V-window** settings later (see index at back of book).*

*2. In the **RUN-MAT** icon you* **do not** *have access to the **G-Solv**e features.*

GRAPH icon

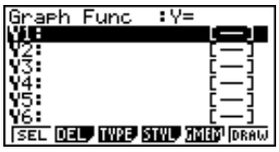


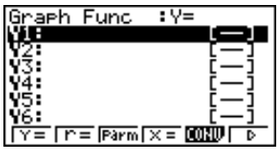
From the **MAIN MENU** enter into the **GRAPH** icon by either moving the cursor to highlight the icon or pressing the **[3]** key.

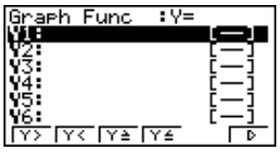
This part of the calculator has a lot of functionality. Stores graphs, up to 20 functions that you use regularly or 'families' of graphs where relationships and special features can be viewed.

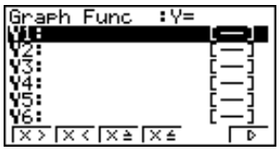
All of the 'Function' key menus, such as **Trace, Zoom, V-Window, Sketch, Graphical Solutions** and **Graph - Text** are also available. It is also where you can view **Graph - Graphs** and **Graph - Table** split screens. The screen is split vertically, giving very good views of what you have chosen to see.

You can draw equations and in-equations, rectangular, parametric and polar graph types. By selecting **[F3]** you can view the different **types**.



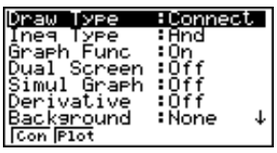


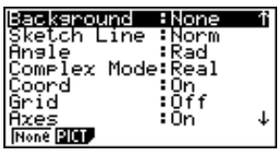


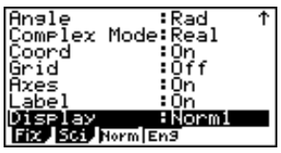


How to chose the calculator settings (Set Up)

KEY	SHIFT	MENU





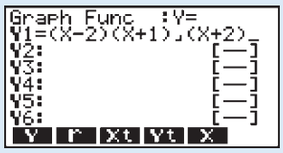
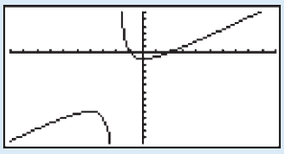
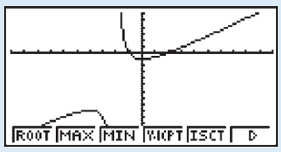


G-Solve features

Once you have drawn a graph then you have access to the **G-Solve** features.

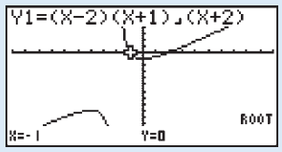
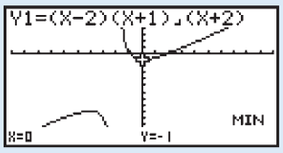
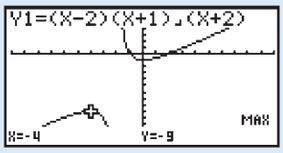
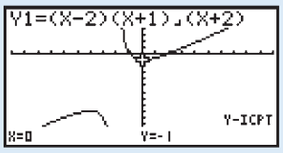
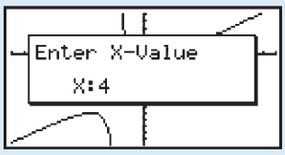
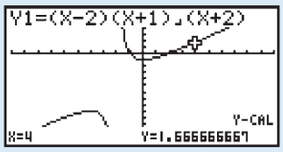
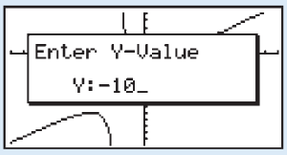
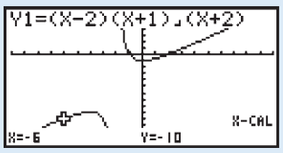
KEY	SHIFT	F1	F2	F3	F4	F5	F6

Example

Collate information about the function $y = \frac{(x-2)(x+1)}{(x+2)}$	*Result*
Store the expression in position Y1 (X,θ,T - 2) (X,θ,T + 1) $a^b/_c$ (X,θ,T + 2) *then* EXE	
Draw the graph F6	
Open the ***G-Solve*** *selections* SHIFT F5	

cont. on next page

GRAPH DRAWING

Find the...			
Root/s SHIFT F5 F1 ▶		*Minimum* SHIFT F5 F3	
Maximum SHIFT F5 F2		*Y-intercept* SHIFT F5 F4	
Y-value calculations SHIFT F5 F6 F1	 	*X-value calculations* SHIFT F5 F6 F2	 

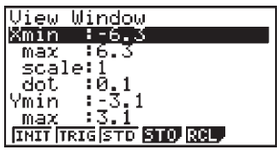
Other **G-Solv**e features are shown in other chapters in this book where appropriate.

Basic activities in the GRAPH icon

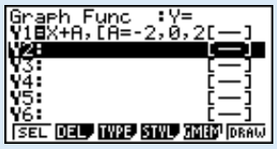
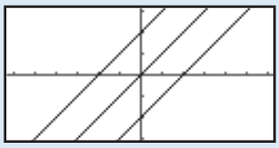
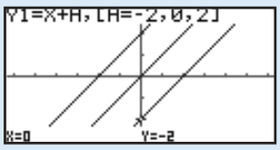
This activity shows how the calculator can be used: to draw multiple lines; to see the relationship to the change in the constant 'c' in y = mx + c and to draw multiple parabolas; to see the relationship to the change in the coefficient 'a' in $y = ax^2 + c$.

A line - multiple representations for y = x + c

Note:
*Make sure that the **V-Window** is appropriate to see the graphs that you will be drawing. Enter **[SHIFT] [F3]** then the option that you require, in this case, **[F1]** for **INIT**ial. Go back to the Graph Function menu with **[EXIT]** or **[EXE]**.*
Using, [A=-2,0,2] at the end if the equation gives the static effect of a 'dynamic graph'.



Example

Draw the graphs of y = x - 2, y = x, y = x + 2	*Result*
X,θ,T + ALPHA X,θ,T , SHIFT + ALPHA X,θ,T SHIFT . - 2 , 0 , 2 SHIFT - *then* EXE	
EXE *or* F6 *You will see these lines drawn one at a time.*	
SHIFT F1 *then* ▲ ▶ ▼ ◀ *'Trace' either of the three graphs.*	

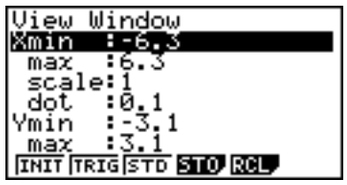
A parabola - multiple representations for y = ax²

Note:

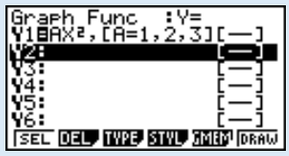
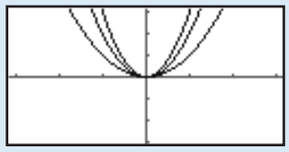
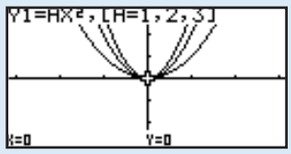
Make sure that the **V-Window** *is appropriate to see the graphs that you will be drawing. Enter* ***[SHIFT] [F3]*** *then change the settings to the conditions shown here.*

Go back to the Graph Function menu with ***[EXE]*** *or* ***[EXIT]*** *.*

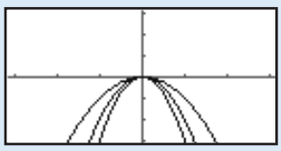
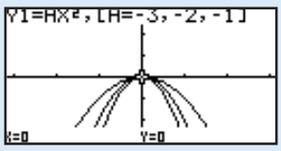
Using, [A=1,2,3] at the end if the equation gives the effect of a 'dynamic graph'.



Example

Draw the graphs of y = 1x², y = 2x², y = 3x²	*Result*
[ALPHA] [X,θ,T] [X,θ,T] [x²] [,] [SHIFT] [+] [ALPHA] [X,θ,T] [SHIFT] [.] [1] [,] [2] [,] [3] [SHIFT] [-] *then* [EXE]	
[EXE] *or* [F6] *You will see parabolas being drawn one at a time.*	
[SHIFT] [F1] *then* [▲] [▶] [▼] [◀] *'Trace' either of the three graphs.*	

Example 2

Draw the graphs of y = -1x², y = -2x², y = -3x²	*Result*
[ALPHA] [X,θ,T] [X,θ,T] [x²] [,] [SHIFT] [+] [ALPHA] [X,θ,T] [SHIFT] [.] [-] [3] [,] [-] [2] [,] [-] [1] [SHIFT] [-] *then* [EXE]	
[EXE] *or* [F6] *You will see parabolas being drawn one at a time.*	
[SHIFT] [F1] *then* [▲] [▶] [▼] [◀] *'Trace' either of the three graphs.*	

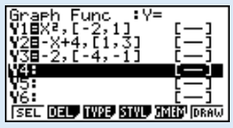
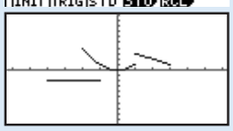
Basic activities in the GRAPH icon cont.

Piecewise Functions

Note:
Piecewise functions are pieces of different functions, restricted in the domain (x-values) for which they are to be drawn.

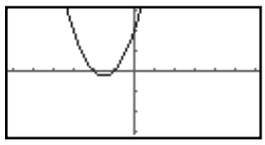
Use [,] to restrict the domain values.

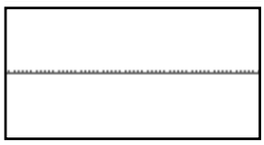
Example

Draw the graphs of $y = x^2$, $-2 \le x \le 1$ $y = -x + 4$, $1 \le x \le 3$ $y = -2$, $-4 \le x \le -2$	*Result*
[X,θ,T] [x^2] [,] [SHIFT] [+] [-] [2] [,] [1] [SHIFT] [-] [EXE] [-] [X,θ,T] [+] [4] [,] [SHIFT] [+] [1] [,] [3] [SHIFT] [-] [EXE] [-] [2] [,] [SHIFT] [+] [-] [4] [,] [-] [1] [SHIFT] [-]	
Set up the V-Window and then draw the graphs. [SHIFT] [F3] *then* [EXE] *or* [F6]	 

If you want to, change the **V**iew-**Window** to **'zoom'** in on the graphs, to get a better picture (view).

You can 'trace' over the graphs by pressing **[SHIFT] [F3]** then use the arrows ▼ ▶ ▲ ◀ to scroll each of the graphs on the screen.





Graph drawing – Zooming in and out

When the **V-Window** (Graph Viewing Window) has not been set up for the graph that you want to see, your screen will look like either of the following images.

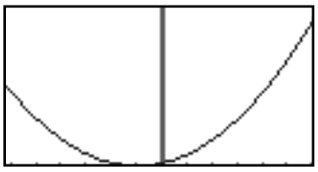
Auto Zoom

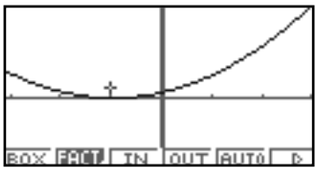
Using the **AUTO ZOOM** the calculator will adjust the axes so that you can see 'your graph' better then you can adjust the **V-Window** to a more appropriate scale to suit what you want.

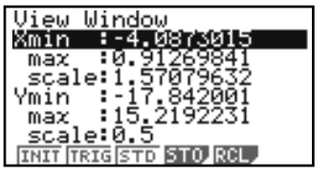
KEY	

To get **AUTO ZOOM** press **[SHIFT] [F2]** and then **[F5]**.

A cursor appears in the middle of the screen. You can move it to the left, right, up or down to adjust the axes the **[EXE]** to redraw.



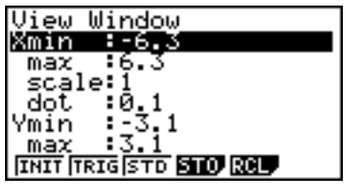
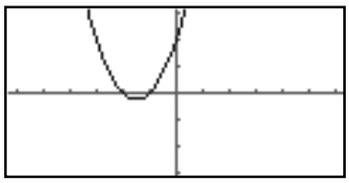
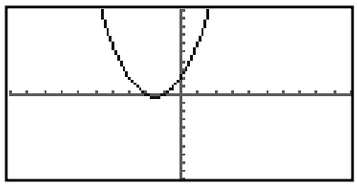




cont. on next page

Auto Zoom cont.

The most important viewing windows are:

INITial Setting 	 View Window Xmin :-6.3 max :6.3 scale:1 dot :0.1 Ymin :-3.1 max :3.1 INIT TRIG STD STO RCL	
STan**D**ard Setting 	View Window Xmin :-10 max :10 scale:1 dot :0.15873015 Ymin :-10 max :10 INIT TRIG STD STO RCL	

Note:
The more graphs that you experience drawing on the FX9750GII the more familiar you will get with understanding the relationship between the graphs and their equations that are represented algebraically.

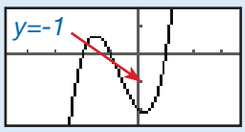
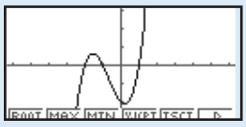
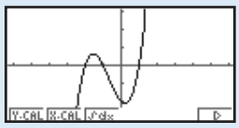
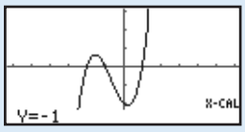
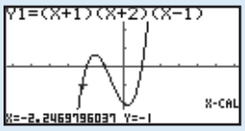
TRIG Setting 	View Window Xmin :-540 max :540 scale:90 dot :8.57142857 Ymin :-1.6 max :1.6 INIT TRIG STD STO RCL Degree	**OR**	View Window Xmin :-9.4247779 max :9.42477796 scale:1.57079632 dot :0.14959965 Ymin :-1.6 max :1.6 INIT TRIG STD STO RCL Radian measure

Trigonometric graphs have two settings that are used most often, depending what angular measure you are in.

Graphing and calculating unknown x values

When finding the x-value(s), given a y-value, make sure that the **V-Window** is set up to see the graph.

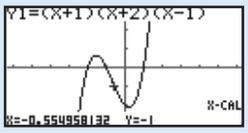
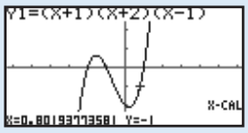
Example

For y = (x + 1) (x + 2) (x - 1) calculate x when y = -1	*Result*
(X,θ,T + 1) (X,θ,T + 2) (X,θ,T - 1) *then* EXE *or* F6	 Graph Func :Y= Y1=(X+1)(X+2)(X-[—] Y2: [—] Y3: [—] Y4: [—] Y5: [—] Y6: [—] SEL DEL TYPE STYL GMEM DRAW 
SHIFT F5 *then* F6 *for G-Solve (helps find x-values or y-values from graphs)*	 
F2 *for X-CAL (x-calculation)* *then* - 1 *then* EXE	 

cont. on next page

Basic activities in the GRAPH icon cont.

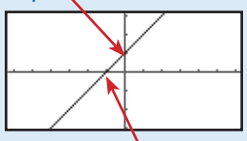
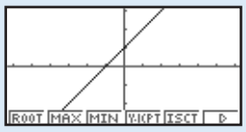
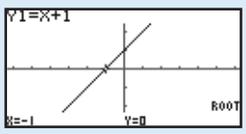
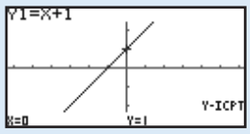
Graphing and calculating unknown x-values

[▶] *or* [◀] *to view multiple solutions*	 

Graphing and intercepts

Finding the x–intercepts (roots to the equation when y = 0) and the y–intercepts (x = 0). Make sure that the **V-Window** is set up to see the graph efficiently.

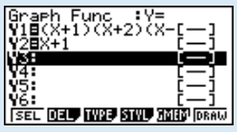
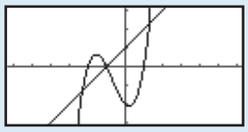
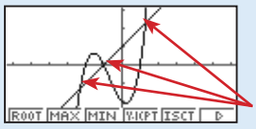
Example

Graph y = x+1	*Result*
[X,θ,T] [+] [1] *then* [EXE] *or* [F6]	*y-intercept*   *x-intercept*
[SHIFT] [F5] *for G-Solve (helps find x- and y-intercepts).*	
[F1] *for ROOT (x-intercept)* [F4] *for Y-ISCT (y-intercept)*	 

Graphing two equations and finding the intersection points.

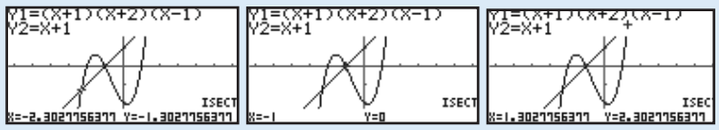
Finding the intersection points of two graphs, where f (x) = g(x).Make sure that the **V-Window** is set up to see the graph efficiently.

Example

Solve y = (x + 1) (x + 2) (x - 1) and y = x + 1 simultaneously to find the points of intersection.	*Result*
[(] [X,θ,T] [+] [1] [)] [(] [X,θ,T] [+] [2] [)] [(] [X,θ,T] [-] [1] [)] *then* [EXE] [X,θ,T] [+] [1] *then* [EXE] *or* [F6]	 
[SHIFT] [F5] *for G-Solve (helps find intersection points).*	 *intersection points*

cont. on next page

Example cont.

[F5] *for **ISCT** (intersection points)* [▶] *to find all others*	

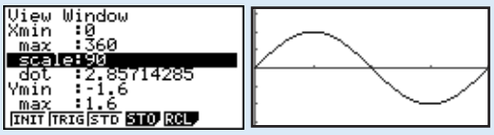
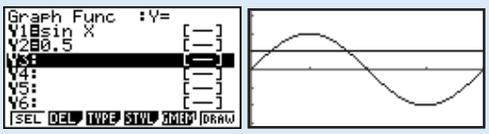
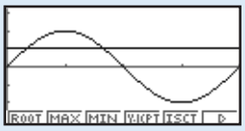
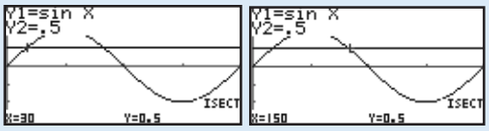
Solving trigonometric equations

It is necessary to check that the domain (x-coordinates) and range (y-coordinates) are set up for graphing trigonometric graphs, through the **V-Window** (**[SHIFT] [F3]**).

By pressing the **[F2]** key this sets the calculator up for **TRIG**onometric graphs. You can alter the settings by overriding what is already there.

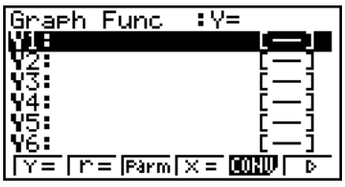
KEY	

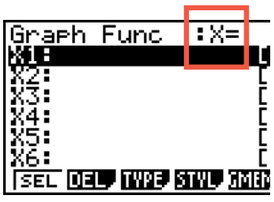
Example

Solve sin x = 0.5 between 0° ≤ x ≤ 360°	*Result*
[sin] [X,θ,T] *then* [EXE]	
[SHIFT] [F3] *then* [F2] *Set up for TRIG graphs* [EXIT] *then* [EXE] *or* [F6] *to draw the sine curve*	
[EXIT] [▼] *into Y2* *then* [0] [.] [5] *and* [EXE] *to store* [EXE] *or* [F6] *to draw both graphs*	
[SHIFT] [F5] *then* [F5] *for G-Solve (solves the two graphs simultaneously)*	
[◀] [▶] *Search for the next solution* *The two solutions are x = 30° and 150°*	

Solving 'X=…' equations.

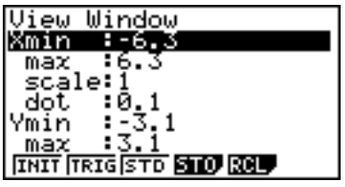
x = y entry rather than y = x in **GRAPH** mode.
Selecting **TYPE [F3]** gives you access to a number of different graph types that can be drawn.

For "X ="	
	



Note:
That the Graph Function at the top of the screen changes to : X=

*To enter 'Y' use the **[ALPHA]** key and then the **[—]** key*



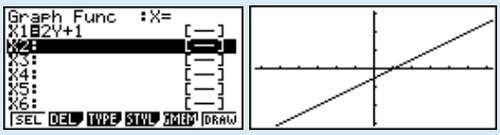
*Use this **V-Window.***

GRAPH DRAWING

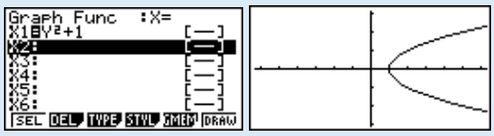
Basic activities in the GRAPH icon cont.

Solving 'X=…' equations.

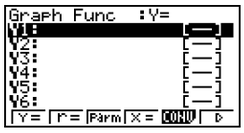
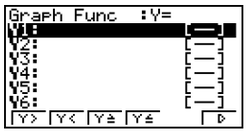
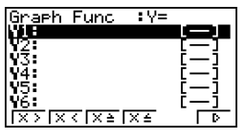
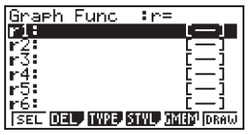
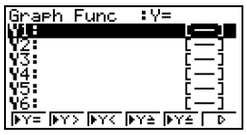
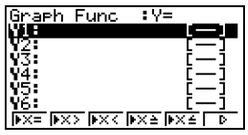
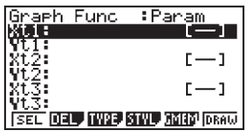
Example

Draw x = 2y + 1	*Result*
F3 F4 2 ALPHA — + 1 *then* EXE *then* EXE *or* F6 *to draw the graph*	

Example 2

Draw x = y^2 + 1	*Result*
F3 F4 ALPHA — x^2 + 1 *then* EXE *then* EXE *or* F6 *to draw the graph*	

Other settings under **TYPE [F3]**:

Rectangular 		Inequalities 	 
Polar 		**CONV***ert* 	 
Parametric 			

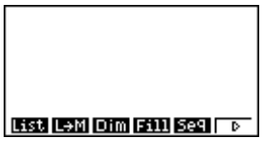
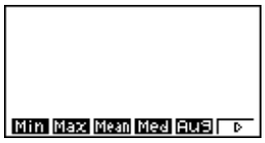
Notes:

OPTN, VARS and CATALOG

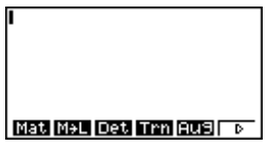
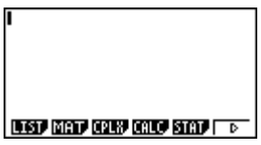
KEY	OPTN VARS CATALOG P 4

These mathematical tools can be selected in most of the **MAIN MENU** icons, namely, **RUN-MAT, Statistics, Graph, Dynamic Graph, Tables** and **Program**. The **OPTION** key will bring these tools up on the screen for use.

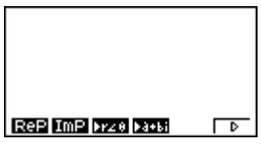
What is in List?

KEY	OPTN	F1	F6	F6
RESULT				

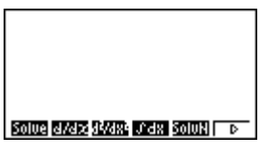
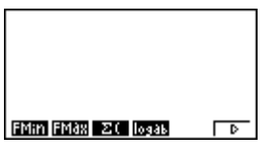
What is in Matrix?

KEY	OPTN	F2	F6
RESULT			

What is in Complex?

KEY	OPTN	F3	F6
RESULT			

What is in Calculus?

KEY	OPTN	F4	F6	F6
RESULT				

OPTION, VARIATIONS AND CATALOGUE KEYS

OPTN, VARS and CATALOG cont.

What is in Statistics?

KEY	OPTN	F5	F6
RESULT	LIST MAT CPLX CALC STAT ▷	Σ̄ Σ DIST S-Dev Var ▷	TEST ▷

What is in Conversion?

KEY	OPTN	F6	F1	F6	F6
RESULT	LIST MAT CPLX CALC STAT ▷	CONV HYP PROB NUM ANGL ▷	▶ LENG AREA VLUM TIME ▷	▶ TMPR VELO MASS FORC ▷	▶ PRES ENGY PWR ▷

What is in Hyperbolic?

KEY	OPTN	F6	F2
RESULT	LIST MAT CPLX CALC STAT ▷	CONV HYP PROB NUM ANGL ▷	sinh cosh tanh sinh⁻¹ cosh⁻¹ tanh⁻¹

What is in Probability?

KEY	OPTN	F6	F3	F6
RESULT	LIST MAT CPLX CALC STAT ▷	CONV HYP PROB NUM ANGL ▷	x! nPr nCr RAND ▷	P(x) Q(x) R(x) t(x) ▷

KEY	OPTN	F6	F3	F4
RESULT	Ran# Int Norm Bin List			

CASIO®

What is in Number?

KEY	OPTN	F6	F4	F6
RESULT	LIST MAT CPLX CALC STAT ▷	CONV HYP PROB NUM ANGL ▷	Abs Int Frac Rnd Ints ▷	RndFi GCD LCM MOD MOD:B ▷

What is in Angle?

KEY	OPTN	F6	F5	F6
RESULT	LIST MAT CPLX CALC STAT ▷	CONV HYP PROB NUM ANGL ▷	° r g °''' ▷	Pol(Rec(▶DMS ▷

What is in E Symmetry?

KEY	OPTN	F6	F6	F1
RESULT	LIST MAT CPLX CALC STAT ▷	CONV HYP PROB NUM ANGL ▷	ESYM PICT FMEM LOGIC CAPT ▷	m μ n p f ▷

KEY	F6	F6
RESULT	k M G T P ▷	P ENG ENG ▷

What is in Picture?

KEY	OPTN	F6	F6	F2
RESULT	LIST MAT CPLX CALC STAT ▷	CONV HYP PROB NUM ANGL ▷	ESYM PICT FMEM LOGIC CAPT ▷	Sto Rcl

OPTION, VARIATIONS AND CATALOGUE KEYS

OPTN, VARS and CATALOG cont.

What is in Function Memory?

KEY	OPTN	F6	F6	F3
RESULT	LIST MAT CPLX CALC STAT ▷	CONV HYP PROB NUM ANGL ▷	ESYM PICT FMEM LOGIC CAPT ▷	STO RCL fn SEE

What is in Logic?

KEY	OPTN	F6	F6	F4
RESULT	LIST MAT CPLX CALC STAT ▷	CONV HYP PROB NUM ANGL ▷	ESYM PICT FMEM LOGIC CAPT ▷	And Or Not

What is in Capture?

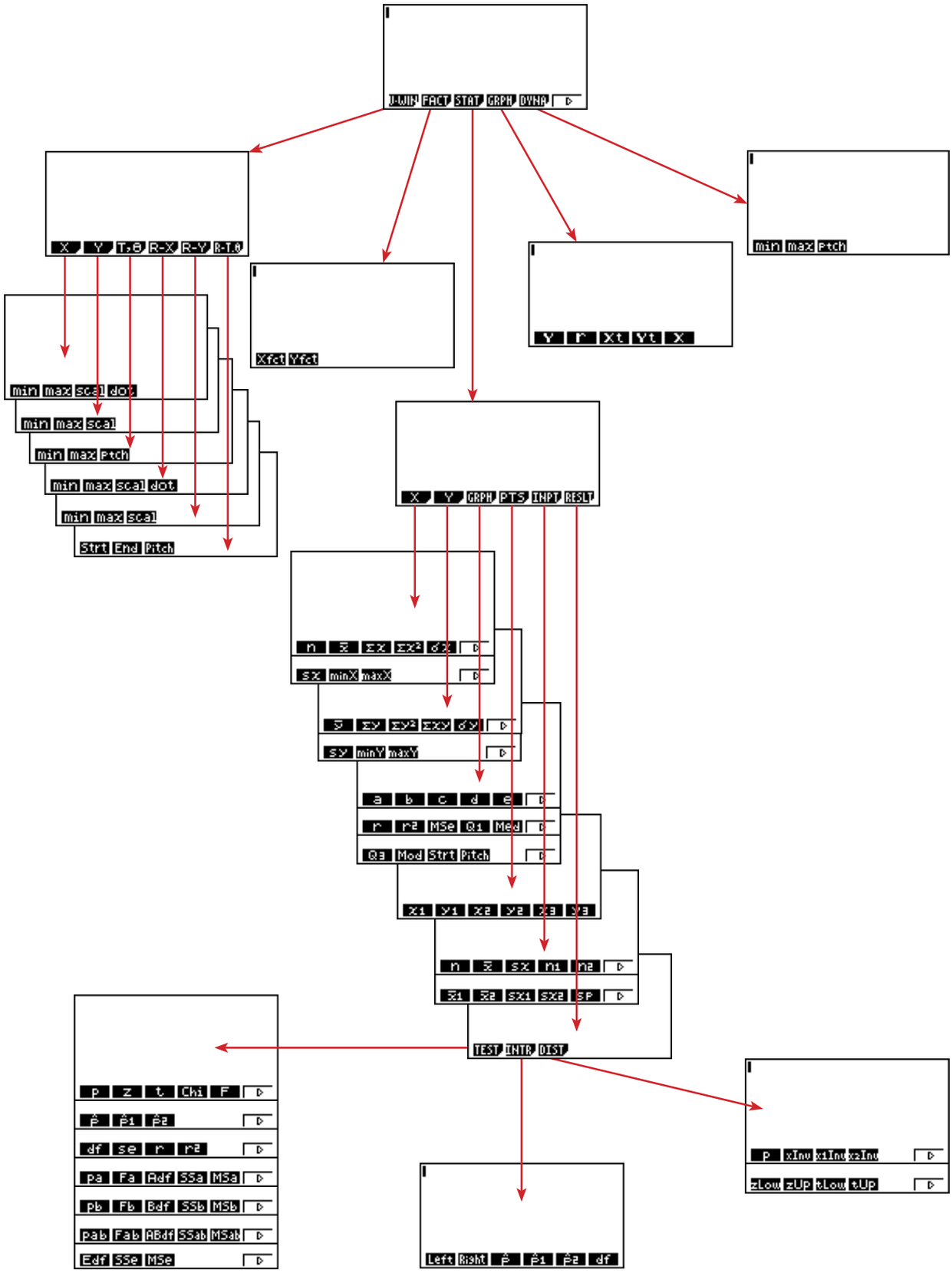
KEY	OPTN	F6	F6	F5
RESULT	LIST MAT CPLX CALC STAT ▷	CONV HYP PROB NUM ANGL ▷	ESYM PICT FMEM LOGIC CAPT ▷	RCL

What is in Time, Value and Money?

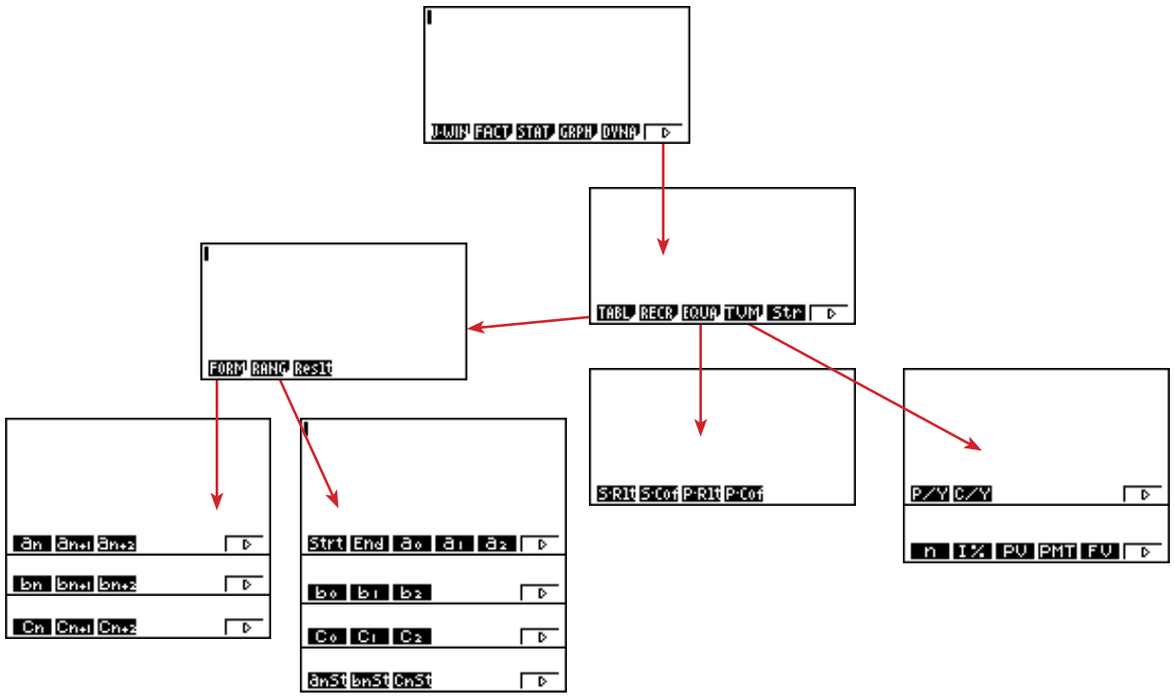
KEY	OPTN	F6	F6	F6
RESULT	LIST MAT CPLX CALC STAT ▷	CONV HYP PROB NUM ANGL ▷	ESYM PICT FMEM LOGIC CAPT ▷	TVM ▷

KEY	F1	F6
RESULT	SMPL IMPD CASH AMT CHVT ▷	COST DAYS BOND ▷

The **VARIATIONS** key will provide commands, settings, values and solutions to equations namely: **V-Window, Factor, Statistics, Graph, Dynamic graph, Table, Recursion, Equation, Financial (TVM)** and **String.**



OPTION, VARIATIONS AND CATALOGUE KEYS



CATALOGue Key

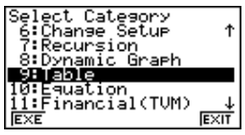
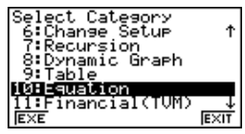
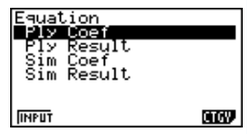
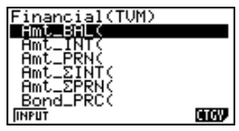
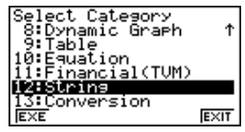
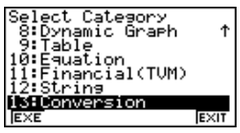
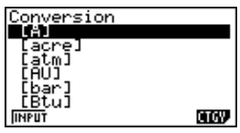
The **CATALOG**ue Key provides a list of mathematical symbols, commands to enter. These can be accessed through most of the **MAIN MENU** icons using the **OPTN** or **VARS** keys.

KEY	OPTN	VARS	SHIFT	CATALOG P 4

They can also be accessed via **[SHIFT] [4]** where you will need to scroll a list and select the required command required.

The catalogue can be viewed through 13 different catalogues that are linked to the **MAIN MENU** icons for easier access to the commands required.

	Catalogue Screen	Next Screen		Catalogue Screen	Next Screen
All	Select Category 1:All 2:Calculation 3:Statistics 4:Graph 5:Program Command 6:Change Setup EXE EXIT	Catalog a(Reg) [A] a+bi a0 a1 INPUT CLOV	**Calculation**	Select Category 1:All 2:Calculation 3:Statistics 4:Graph 5:Program Command 6:Change Setup EXE EXIT	Calculation ▸a+bi Abs Arg Augment(C Conjg INPUT CLOV
Statistics	Select Category 1:All 2:Calculation 3:Statistics 4:Graph 5:Program Command 6:Change Setup EXE EXIT	Statistics a(Reg) ABdf Adf Augment(b(Reg) Bar INPUT CLOV	**Graph**	Select Category 1:All 2:Calculation 3:Statistics 4:Graph 5:Program Command 6:Change Setup EXE EXIT	Graph BrokenThickG Circle ClrGraph Cls DotG DrawGraph INPUT CLOV
Program Command	Select Category 1:All 2:Calculation 3:Statistics 4:Graph 5:Program Command 6:Change Setup EXE EXIT	Program Command And Break CloseComport38k ClrMat ClrText Do INPUT CLOV	**Change Setup**	Select Category 1:All 2:Calculation 3:Statistics 4:Graph 5:Program Command 6:Change Setup EXE EXIT	Change Setup a+bi ab/c AxesOff AxesOn BG-None BG-Pict INPUT CLOV
Recursion	Select Category 6:Change Setup 7:Recursion 8:Dynamic Graph 9:Table 10:Equation 11:Financial(TVM) EXE EXIT	Recursion a0 a1 a2 an an+1 an+1Type INPUT CLOV	**Dyanmic Graph**	Select Category 6:Change Setup 7:Recursion 8:Dynamic Graph 9:Table 10:Equation 11:Financial(TVM) EXE EXIT	Dynamic Graph D End D Pitch D SelOff D SelOn D Start D Var INPUT CLOV

	Catalogue Screen	Next Screen		Catalogue Screen	Next Screen
Table			**Equation**		
Financial (TVM)			**String**		
Conversion					

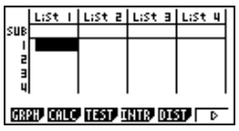
The mathematical and statistical commands available in **CATALOG**ue can be accessed via the **OPTN** or **VARS** keys also.

Notes:

STATISTICS

The statistics icon incorporates the two types:

- Univariate (1 variable)
- Multivariate (2 variables).

KEY		RESULT	

There are 24 'list' spaces that you can enter data into. Lists 1 to 24 can be used in any order. The lists can be used as frequency values also. Note that you can only see 4 lists at a time.

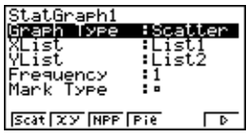
The distinction between the lists and what you propose to do with them is determined by the way you set up the calculation or graph types required and the lists you are using to calculate the numerical statistics and drawing statistical graphs.

Three independent graphs can be set up as univariate or multivariate data from different or from the same lists.

[F1] [F6] to **SET** up the statistical graph types.

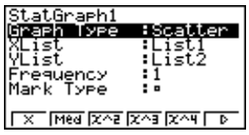
Graphing options are:

F1 **Scatter Graph**
F2 **Line Regression**
F3 **Time Series**
F4 **Pie Chart**



F1 **Histogram**
F2 **Box and Whisker Plot (Median)**
F3 **Bar Graph**
F4 **Normal Distribution**
F5 **Broken (Frequency Polygon)**

F1 **Linear Regression**
F2 **Median/Median Regression**
F3 **Quadratic Regression**
F4 **Cubic Regression**
F5 **Quartic Regression**



F1 **Logarithm Regression**
F2 **Exponential Regression**
F3 **Power Regression**
F4 **Trigonometric Regression**
F5 **Logistic Regression**

Data Entry

You can enter up to 999 data points in each 'list' space.

Note: *Memory space is approximately 64000 (64k) bytes and using large data sets can utilise a lot of memory space.*

Uni-variate

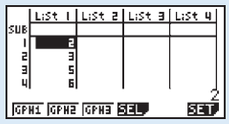
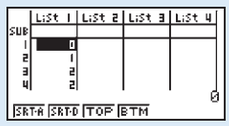
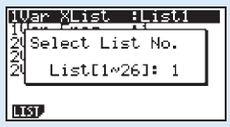
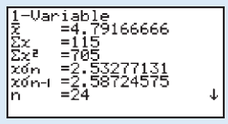
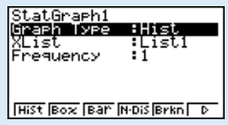
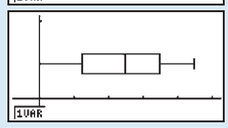
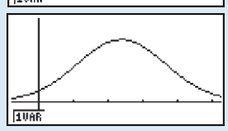
Example

In 'List 1' enter the following data. Find all of the central measures values. Draw the Box and Whisker, Histogram and Normal Distribution approximation for this data.

2	3	5	6	8	7	5	3	2	9	7	4
2	1	0	9	6	8	5	3	7	6	2	5

cont. on next page

Uni-variate cont.

Example cont.	Result
[2] [EXE] [3] [EXE] [5] [EXE] [6] [EXE] [8] [EXE] [7] [EXE] [5] [EXE] [3] [EXE] [2] [EXE] [9] [EXE] [7] [EXE] [4] [EXE] [2] [EXE] [1] [EXE] [0] [EXE] [9] [EXE] [6] [EXE] [8] [EXE] [5] [EXE] [3] [EXE] [7] [EXE] [6] [EXE] [2] [EXE] [5] [EXE] ***Note:*** *Wrongly entered scores can be edited by moving to the appropriate cell with the [▲] [▶] [▼] [◀] and typing over the score and pressing [EXE]*	
Sorting data entries: [F6] [F1] [F1] *Ascending (lowest to highest)* ***(SRT-A)*** [F6] [F1] [F2] *Descending (highest to lowest)* ***(SRT-D)*** *Enter how many list(s) to sort and then which list(s)*	
Calculate statistics for this set of scores: [F2] *[CALC]* [F6] *[SET]* [F1] [1] *Set the list to be calculated from then* [EXIT] *Make sure "1Var Freq" is set to 1* [F1] *[1 VAR] for the calculated statistics*	
[▲] [▼] *Scroll through the complete set of calculated statistics*	
You can now set up the calculator to draw the statistical graphs [EXIT] [F6] *to return to the main screen* [F1] *[GRPH]* [F6] *[SET]* [F1] *[GRPH1]* [▼] *[Graph Type]* [F6] *then* [F1] *[HIST]* *or* [F2] *[GPH2]* [▼] *[Graph Type]* [F6] *then* [F2] *[BOX]* *or* [F3] *[GPH3]* [▼] *[Graph Type]* [F6] *then* [F4] *[N-Dis]* ***Note:*** *You can set up any graph in any of the three [GRAPH] spaces*	  
[EXIT] *then* [F1] *then* [EXE] *or* [F2] *or* [F3] *Graph/s have been drawn* ***Note:*** *Lists (data) can be copied, sorted, altered and placed into other 'list' areas.*	  

Uni-variate cont.

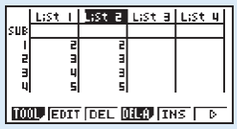
Example 2

Enter the following data into list 1 and list 2 spaces to calculate summary statistics from given data. Set up the lists so the List 1 is the x-values, List 2 is the frequency values.

Score x - List 1	2	3	4	5	6	7	8
Frequency f - List 2	2	3	3	5	4	2	1

Result

[2] [EXE] [3] [EXE] [4] [EXE] [5] [EXE] [6] [EXE] [7] [EXE] [8] [EXE] *then* [▶] [2] [EXE] [3] [EXE] [3] [EXE] [5] [EXE] [4] [EXE] [2] [EXE] [1] [EXE]

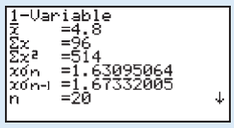


[F2] [F6] *then* [F1] [1] [EXE] *List 1 is now entered as the x-values*

[▼] *then* [F2] [2] [EXE] *List 2 is now entered as the frequency*

[EXIT] [F1] *Summary statistics*

[▲] [▼] *Scroll through the complete set of calculated statistics*



Bi-variate data

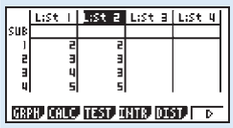
Example

Enter the following 2 variable statistics and graph a linear regression model of the data. Set up the lists so the List 1 is the Mathematics (x-values), List 2 is the English (y values).

Student	a	b	c	d	e	f	g
Mathematics x - List 1	2	3	4	5	6	7	8
English y - List 2	2	3	3	5	6	7	6

Result

[2] [EXE] [3] [EXE] [4] [EXE] [5] [EXE] [6] [EXE] [7] [EXE] [8] [EXE] *then* [▶] [2] [EXE] [3] [EXE] [3] [EXE] [5] [EXE] [6] [EXE] [7] [EXE] [6] [EXE]



[F2] [F6] *then* [▼] [▼] [F1] [1] [EXE] *List 1 is entered as the x-values*

[▼] *then* [F1] [2] [EXE] *List 2 is entered as the y-values*

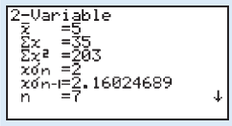
[▼] [F1] *Frequency is set at 1*

Data has been set up to calculate in regression format.

Note: *This calculator model performs a Least Squares regression model*

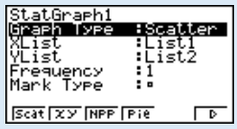
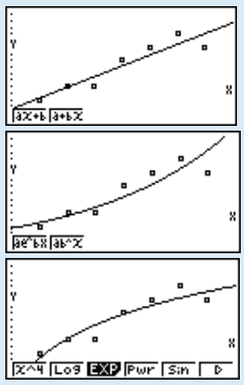
[EXIT] [F2] *Summary statistics*

[▲] [▼] *Scroll through the complete set of calculated statistics*



cont. on next page

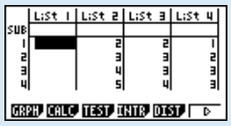
Bi-variate cont.

Example cont.	*Result*
You can now set up the calculator to draw the graph in regression format [EXIT] [F6] *to return to the main screen* [F1] *[GRPH]* [F6] *[SET]* [F1] *[GPH1]* [▼] *[Graph Type]* [F1] *[SCAT]*	
[EXIT] *then* [F1] *Graph has been drawn*	
Select the mathematical models to fit the data points [F1] *[CALC]* [F2] [F1] [F6] *Linear model* *or* [F6] [F3] [F1] [F6] *Exponential model* *or* [F6] [F2] [F6] *Logarithmic model*	

Example 2

Enter the following two variable statistics and graph a linear regression model for the data. Set up the lists so the List 2 is the x-values, List 3 is the y-values and List 4 is the frequency.	*Result*

Student	*a*	*b*	*c*	*d*	*e*	*f*	*g*
Mathematics x - List 2	2	3	4	5	6	7	8
English y - List 3	2	3	3	5	6	7	6
Frequency f - List 4	1	2	1	1	3	2	1

[2] [EXE] [3] [EXE] [4] [EXE] [5] [EXE] [6] [EXE] [7] [EXE] [8] [EXE] *then* [▶] [2] [EXE] [3] [EXE] [3] [EXE] [5] [EXE] [6] [EXE] [7] [EXE] [6] [EXE] *then* [▶] [1] [EXE] [2] [EXE] [1] [EXE] [1] [EXE] [3] [EXE] [2] [EXE] [1] [EXE]	
[F2] *[CALC]* [F6] *[SET] then* [▼] [▼] [F1] [2] [EXE] *List 2 is entered as the x-values* [▼] *then* [F1] [3] [EXE] *List 3 is entered as the y-values* [▼] [F2] [4] [EXE] *List 4 is entered as the frequency* *Data has been set up to calculate in regression format.*	

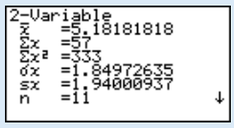
cont. on next page

Bi-variate cont.

Example 2 cont.

[EXIT] [F2] *Summary statistics*

[▲] [▼] *Scroll through the complete set of calculated statistics*



Editing Lists

As mentioned earlier, lists can also be used for storing many types of lists. For example, recursive sequences and partial series, table values, statistical trends etc.

KEY	OPTN

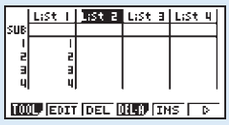
Example

Consider the following list. Enter it into List 1. Then in List 2, you require 2×List 1.

List 1	1	2	3	4	5	6	7	8	9
List 2	2	4	6	8	10	12	14	16	18

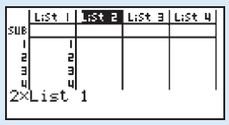
Result

[1] [EXE] [2] [EXE] [3] [EXE] [4] [EXE] [5] [EXE] [6] [EXE] [7] [EXE] [8] [EXE] [9] [EXE]

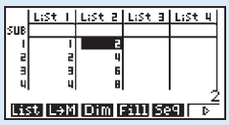


then [▶] [▲] *to place cursor into the List 2 column heading*

then [2] [x] [OPTN] [F1] *[List]* [F1] [1] [EXE]



[EXE]



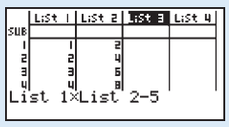
Enter the following list into List 1. Then in List 3, you require List 1×List 2 - 5.

List 1	1	2	3	4	5	6	7	8	9
List 2	2	4	6	8	10	12	14	16	18
List 3									

Result

then [▶] [▲] *to place cursor into the List 3 column heading*

then [OPTN] [F1] *[List]* [F1] [1] [x] [OPTN] [F1] [F1] [2] [-] [5] [EXE]



[EXE]

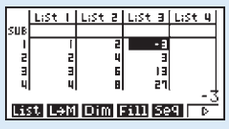


Table values generated in the **TABLE** icon from the **MAIN MENU** can be transferred to the **STAT** area.

Lists (data) can be copied, sorted, altered and placed into other 'list' areas. Place the cursor into the List column heading **(destination column)**. Now press **[OPTN]**, **[F1]** for List and **[F1]** again followed by the list number then **[EXE]**.

Deleting Lists

Deleting list entries use either **[F6]** then **[F3]** for one entry at a time or use the **[DEL]** key when in the cell to be deleted. To delete the entire column use **[F6] [F4]** then **[F1]**.

Note:
You cannot delete rows, only columns or individual cell entries.

Normal, Binomial and Poisson distributions are covered in depth in Chapter 7.

Notes:

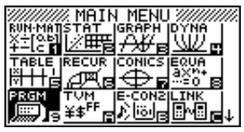
PROGRAMMING

PROGRAMMING icon

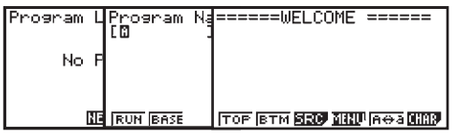
The programming icon is an area where programmes can be written, edited, retrieved and deleted.

Access to the programming tools are through the **PRGM** key.

KEY	SHIFT	VARS



When you have no programmes, the first few screens will look like the images to the left. When you have programmes you will see the screens to the right.



OR

The language is very similar to the computer language **BASIC**.

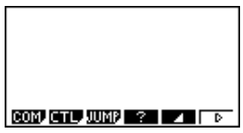
F1	F2	F3	F4	F5	F6 F1	F6 F2	F6 F3	F6 F4	F6 F5	F6 F6 F1
COM	CTL	JUMP	?	◢	CLR	DISP	REL	I/O	:	STR

An error in the program when it is being **RUN**, will be highlighted by an error message at the place the error occurs. By using the left **REPLAY** button, the calculator will automatically go to the error in the program, so it can be edited.

Shown below are the various screens that contain the programming tools used in writing and editing programs. The manual discusses these tools in more detail, please view the appropriate pages. In preparing a programme **FLOW DIAGRAMS** are useful, as are **DESK CHECKS.**

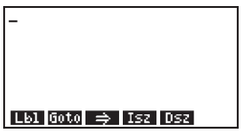
Note: *In this part of the graphic calculator your imagination is the only limitation on what you can do!*

The Programming Tools Menu

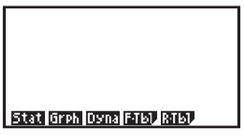
KEY	SHIFT VARS	RESULT	  

KEY	F1	RESULT	  

KEY	F2	RESULT	

KEY	F3	RESULT	

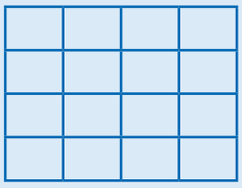
KEY	F6 F1	RESULT	

KEY	F6 F2
RESULT	

KEY	F6 F3	RESULT	

Example

'Rain on the Roof' *is a simulation of raindrops that have fallen on a roof (that has been divided into 16 square) in a 'snapshot' in time.*



This is a Poisson Distribution activity that lets the 'user' decide how many raindrops are to fall. Bar graphs can be drawn to show the distribution to the number of raindrops that have fallen into each square.

How many raindrops are to fall is given by the input value: ***G***

```
'RAIN ON THE ROOF' ↵
"HOW MANY RAIN DROPS?"
? →G ↵
ViewWindow 0,16.15,1,0,16,1 ↵
Graph Y=4:Graph Y=8:
Graph Y=12:Graph Y=16 ↵
Graph X=4:
Graph X=8:
Graph X=12:
Graph X=16 ↵
0→N↵
Lbl 1↵
Int (Ran#x16)→A↵
Int (Ran#x16)→B↵
Plot A+1⌋2,B+1⌋2↵
N+1→N↵
N>G⇒Goto 2↵
Goto 1↵
Lbl 2↵
0→N
```

Another related activity could be:
How many currants are in the currant bun?

This could have the variation of how many currants are necessary to put in the baker's mix to have at least 5 (say) currants in each bun. Look at median, mean, standard error, maximum values and calculations from sample simulations.

Refer to the 'Programme Mode Command List' for entering and editing the program. (See index for page reference).

Example 2

'Number Guess Game'. *The input number is entered and the reply from the program is a 'too high' or 'too low'. You have 7 chances!*

This is a good strategy and logic game, compare the game with the notion of folding a piece of paper in half over and over again.

The 'lowest score' is kept in memory space 'L'. When you exit the game or turn the calculator off the memory of 'L' is returned to the original setting of 8. Happy guessing!

Refer to the 'Programme Mode Command List' for entering and editing the program. (See index for page reference)

```
'NUMBER GUESS' ↵
"  GAME"↵
8 → L ↵
Lbl 1↵
0→C↵
"GUESS A NUMBER"↵
"  PLEASE"↵
Int (Ran#x101)→N↵
"THAT IS BETWEEN 0≤X≤100
YOUR GUESS IS..."↵
Lbl 2↵
?→G↵
C+1→C↵
G=N⇒Goto 5↵
C=7⇒Goto 4↵
G>N⇒Goto 3↵
"TOO LOW"↵
"GUESS AGAIN"↵
Goto 2↵
Lbl 3↵
"TOO HIGH"↵
"GUESS AGAIN"↵
Goto 2↵
Lbl 4 ↵
"OUT OF GUESSES TRY
AGAIN"↵
"THE NUMBER WAS"↵
N◢
Goto 6↵
Lbl 5↵
"YOU GOT IT IN"↵
C◢
"GUESSES"↵
C<L⇒C→L↵
"LOWEST YET"↵
Lbl 6↵
L=100⇒Goto 1↵
"LOWEST SO FAR" :L◢
Goto 1
```

Example 3

'Factors of Numbers', *is a program that finds all factors of any input number, checks whether it is prime, and / or a perfect number and counts the number of factors.*

A program that can stimulate a project on 'Special Numbers', for example.

The calculator executes about 550 calculations a minute. Try checking some of those 2^n-1 primes!

Refer to the 'Programme Mode Command List' for entering and editing the program. (See index for page reference)

```
"FACTOR OF NUMBERS" ↵
Lbl 0↵
?→A↵
0→Z↵
0→K↵
0→N↵
Lbl 1↵
0→B↵
0→C↵
0→D↵
K+1→K↵
Int (A÷K)→B↵
A÷K→C↵
B-C→D↵
D=0⇒K◢
D=0⇒N+1→N↵
D=0⇒B+Z→Z↵
A=K⇒Goto 2↵
Goto 1↵
Lbl 2↵
"INPUT NUMBER"↵
A◢
"PERFECT NUMBER CHECK"↵
Z◢
""↵
N=2⇒Goto 3↵
Z=2xA⇒"THE INPUT NUMBER
IS A
PERFECT NUMBER"↵
""↵
"THERE ARE"↵
N◢
"FACTORS"↵
"ALL FACTORS ARE NOW
FOUND"↵
""↵
"PLEASE TRY AGAIN"↵
Goto 0↵
Lbl 3↵
"THE INPUT NUMBER IS A
 PRIME NUMBER"↵
```

Example 4

*The **'Mendelbrot'** is a well-known use of imaginary numbers, named after its discoverer, the US mathematician Benoit Mendelbrot. The program draws part of the Mendelbrot Set.*

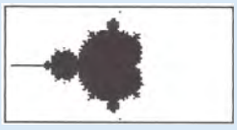
'Zooming In' on a specific part of the Mendelbrot Set can be done by editing the Viewing Window in the first 4 lines of the program.

The set is related to the complex function $f(z)=z^2 + c$, with c being a constant. Many 'spikes' are evident around the boundaries and are very similar to each other, that is, they are smaller versions of the larger ones The program requires a lot of calculations to be made, as the screen is set to 127x63x30. That is, about ¼ million calculations in total.

Try the View Window at:

(a) -1.5 < x < -1.1 and -0.1 < y < 0.1

(b) -0.8 < x < -0.4 and 0.5 < y < 0.7 for example



Refer to the 'Programme Mode Command List' for entering and editing the program. (See index for page reference)

```
"MENDELBROT" ↵
-2→Xmin↵
0.5→Xmax↵
-1→Ymin↵
1→Ymax↵
(Ymax-Ymin)÷62→V↵
(Xmax-Xmin)÷126→H↵
Xmin→X↵
Ymin→Y↵
While X<Xmax+H↵
While Y<Ymax+V↵
X+iY→Z↵
0→N↵
Z→C↵
While Abs Z<2 And N<30↵
Z²+C→Z↵
N+1→N↵
WhileEnd↵
If N>29↵
Then Plot X, Y↵
IfEnd↵
Y+V→Y↵
WhileEnd↵
Ymin→Y↵
X+H→X↵
WhileEnd↵
Stop
```

Example 5

'Fractal-Fern' *is a program that draws a fern. Editing the program can create a fern tessellation by using a series of extra loops, and dummy variables to create the fern.*

Refer to the 'Programme Mode Command List' for entering and editing the program. (See index for page reference)

```
"FRACTAL-FERN" ↵
ViewWindow 1,14,0,1,11,0↵
0→C↵
0→H↵
4.3→E↵
Lbl 0↵
H+1→H↵
H>1000⇒Goto 6↵
C→A↵
Plot A+E,B+1↵
Ran#→r↵
r<.01⇒Goto 1↵
r<.07⇒Goto 4↵
r<.85⇒Goto 2↵
Goto 3↵
Lbl 1↵
0→C↵
.16B→B↵
Goto 0↵
Lbl 2↵
.85A+.04B→C↵
-.04A+.85B+1.6→B↵
Goto 0↵
Lbl 3↵
.2A-.26B→C↵
.23A+.22B→B↵
Goto 0↵
Lbl 4↵
-.15A+.2B→C↵
.26A+.24B→B↵
Go to 0↵
Lbl 6↵
Graph Y=-1↵
```

Example 6

'Dice Simulation' *is a program that utilises the 'List' space to draw various statistical graphs and displays the 99% confidence level. Additional statistical information can be obtained by editing the program.*

You must place values into List 1 for the number of throws of the dice that you want. The program will replace these with the randomly generated numbers between 1 and 6.

The maximum list length is 999 or determined by the memory space available.

Refer to the 'Programme Mode Command List' for entering and editing the program. (See index for page reference)

```
"DICE SIMULATION" ↵
?→W↵
1→P↵
Lbl 1↵
Int (Ran#x6)+1→List 1[P]↵
P+1→P↵
P≤W⇒Goto 1↵
Lbl 2↵
ClrGraph↵
S-WindAuto↵
S-Gph1 DrawOn, Hist, List1,1↵
S-Gph2 DrawOff↵
S-Gph3 DrawOff↵
DrawStat↵
S-Gph1 DrawOff↵
S-Gph2 DrawOn,MedBox,List1,1↵
S-Gph3 DrawOff↵
DrawStat↵
S-Gph1 DrawOff↵
S-Gph2 DrawOff↵
S-Gph3 DrawOn,N-Dist,List1,1↵
DrawStat↵
1-Variable List1↵
"x̄+2.58xσn÷√n":
x̄+2.58xσn÷√n◢
"x̄-2.58 xσn÷√n" :
x̄+2.58xσn÷√n◢
```

PROGRAMMING

PROGRAM MODE COMMAND LIST

[SETUP]key

- ANGL
  - Deg — Deg
  - Rad — Rad
  - Gra — Gra
- COOR
  - On — CoordOn
  - Off — CoordOff
- GRID
  - On — GridOn
  - Off — GridOff
- AXES
  - On — AxesOn
  - Off — AxesOff
- LABL
  - On — LabelOn
  - Off — LabelOff
- DISP
  - Fix — Fix_
  - Sci — Sci_
  - Norm — Norm
  - Eng — Eng
- P/L
  - Blue — P/L-Blue
  - Omg — P/L-Orange
  - Grn — P/L-Green
- DRAW
  - Con — G-Connect
  - Plot — G-Plot
- DERV
  - On — DerivOn
  - Off — DerivOff
- BACK
  - None — BG-None
  - Pict — BG-Pict_
- FUNC
  - On — FuncOn
  - Off — FuncOff
- SIML
  - On — SimulOn
  - Off — SimulOff
- S-WIN
  - Auto — S-WindAuto
  - Man — S-WindMan
- LIST
  - File1 — File1
  - File2 — File2
  - File3 — File3
  - File4 — File4
  - File5 — File5
  - File6 — File6
- LOCS
  - On — LocusOn
  - Off — LocusOff
- T-VAR
  - Rang — VarRange
  - LIST
    - List1 — VarList1
    - List2 — VarList2
    - List3 — VarList3
    - List4 — VarList4
    - List5 — VarList5
    - List6 — VarList6
- Σ DSP
  - On — Σ dispOn
  - Off — Σ dispOff

[VARS]key

- V-WIN
  - X
    - min — Xmin
    - max — Xmax
    - scal — Xscl
  - Y
    - min — Ymin
    - max — Ymax
    - scal — Yscl
  - T,θ
    - min — Tθ min
    - max — Tθ max
    - ptch — Tθ ptch
  - R-X
    - min — RightXmin
    - max — RightXmax
    - scal — RightXscl
  - R-Y
    - min — RightYmin
    - max — RightYmax
    - scal — RightYscl
  - R-T,θ
    - min — RightT θ min
    - max — RightT θ max
    - ptch — RightT θ ptch
- FACT
  - Xfct — Xfct
  - Yfct — Yfct
- STAT
  - X
    - n — n
    - x̄ — x̄
    - Σx — Σx
    - Σx2 — Σx2
    - xσn — xσn
    - xσn-1 — xσn-1
    - minX — minX
    - maxX — maxX
  - Y
    - ȳ — ȳ
    - Σy — Σy
    - Σy2 — Σy2
    - Σxy — Σxy
    - yσn — yσn
    - yσn-1 — yσn-1
    - minY — minY
    - maxY — maxY
  - GRPH
    - a — a
    - b — b
    - c — c
    - d — d
    - e — e
    - r — r
    - Q1 — Q1
    - Med — Med
    - Q3 — Q3
    - Mod — Mod
  - PTS
    - x1 — x1
    - y1 — y1
    - x2 — x2
    - y2 — y2
    - x3 — x3
    - y3 — y3
- GRPH
  - Y — Y
  - r — r
  - Xt — Xt
  - Yt — Yt
  - X — X
- DYNA
  - Strt — D_Start
  - End — D_End
  - pitch — D_pitch
- TABL
  - Strt — F_Start
  - End — F_End
  - Pitch — F_pitch
  - Rslt — F_Result
- RECR
  - FORM
    - an — an
    - an+1 — an+1
    - an+2 — an+2
    - bn — bn
    - bn+1 — bn+1
    - bn+2 — bn+2
  - RANG
    - Strt — R_Start
    - End — R_End
    - a0 — a0
    - a1 — a1
    - a2 — a2
    - b0 — b0
    - b1 — b1
    - b2 — b2
    - anSt — anStart
    - bnSt — bnStart
  - Rslt — R_Result
- EQUA
  - S-Rlt — Sim_Result
  - S-Cof — Sim_Coef
  - P-Rlt — Ply_Result
  - P-Cof — Ply_Coef

[PRGM]key

- COM
  - If — If
  - Then — Then_
  - Else — Else
  - IfEnd — IfEnd
  - For — For_
  - To — To_
  - Step — Step
  - Next — Next
  - While — While
  - WEnd — WhileEnd
  - Do — Do
  - LP-W — LpWhile_
- CTL
  - Prog — Prog_
  - Rtn — Return
  - Brk — Break
  - Stop — Stop
- JUMP
  - Lbl — Lbl_
  - Goto — Goto_
  - ⇒ — ⇒
  - Isz — Isz_
  - Dsz — Dsz_
- ? — ?
- ◢ — ◢
- CLR
  - Text — ClrText
  - Grph — ClrGraph
  - List — ClrList
- DISP
  - Stat — DrawStat
  - Grph — DrawGraph
  - Dyna — DrawDyna
  - F-Tbl
    - Tabl — DispF-Tbl
    - G-Con — DrawFTG-Con
    - G-Plt — DrawFTG-Plt
  - R-Tbl
    - Tabl — DispR-Tbl
    - Web — DrawWeb_
    - an-Cn — DrawR-Con
    - Σa-Cn — DrawR Σ-Con
    - an-Pl — DrawR-Plt
    - Σa-Pl — DrawR Σ-Plt
- REL
  - = — =
  - ≠ — ≠
  - > — >
  - < — <
  - ≥ — ≥
  - ≤ — ≤
- I/O
  - Lcte — Locate_
  - Gtky — Getkey
  - Send — Send(
  - Recv — Receive(
- : — :

[ALPHA]key

- ` — `
- " — "
- ~ — ~

[SHIFT]key

- ZOOM
  - Fact — Factor_
- V-WIN
  - V-Win — ViewWindow_
  - Sto — StoV-Win_
  - Rcl — RclV-Win_
- SKETCH
  - Cls — Cls
  - Tang — Tangent_
  - Norm — Normal_
  - Inv — Inverse_
  - GRPH
    - Y= — Graph_Y=
    - r= — Graph_r=
    - Parm — Graph(X,Y)=(
    - x=c — Graph_X=
    - G∫dx — Graph_∫
    - Y> — Graph_Y>
    - Y< — Graph_Y<
    - Y≥ — Graph_Y≥
    - Y≤ — Graph_Y≤
  - PLOT
    - Plot — Plot_
    - Pl-On — PlotOn_
    - Pl-Off — PlotOff_
    - Pl-Chg — PlotChg_
  - LINE
    - Line — Line
    - F-Line — F-Line_
  - Crcl — Circle_
  - Vert — Vertical_
  - Hztl — Horizontal_
  - Text — Text_
  - PIXL
    - On — PxlOn_
    - Off — PxlOff_
    - Chg — PxlChg_
  - Test — PxlTest_

MENU

- STAT
  - DRAW
    - On — DrawOn
    - Off — DrawOff
  - GRPH
    - GPH1 — S-Gph1_
    - GPH2 — S-Gph2_
    - GPH3 — S-Gph3_
    - Scat — Scatter
    - xy — xyLine
    - Hist — Hist
    - Box — MedBox
    - Box — MeanBox
    - N-Dist — N-Dist
    - Brkn — Broken
    - X — Linear
    - Med — Med-Med
    - X^2 — Quad
    - X^3 — Cubic
    - X^4 — Quart
    - Log — Log
    - Exp — Exp
    - Pwr — Power
  - LIST
    - List1 — List1
    - List2 — List2
    - List3 — List3
    - List4 — List4
    - List5 — List5
    - List6 — List6
  - MARK
    - □ — Square
    - × — Cross
    - · — Dot
  - COLR
    - Blue — Blue_
    - Omg — Orange_
    - Grn — Green_
  - CALC
    - 1VAR — 1-Variable_
    - 2VAR — 2-Variable_
    - X — LinearReg_
    - Med — Med-MedLine_
    - X^2 — QuadReg_
    - X^3 — CubicReg_
    - X^4 — QuartReg_
    - Log — LogReg_
    - Exp — ExpReg_
    - Pwr — PowerReg_
- MAT
  - Swap — Swap_
  - ×Rw — *Row_
  - ×Rw+ — *Row+_
  - Rw+ — Row+_
- LIST
  - Srt-A — SortA(
  - Srt-D — SortD(
- GRPH
  - SEL
    - On — G_SelOn_
    - Off — G_SelOff_
  - TYPE
    - Y= — Y=Type
    - r= — r=Type
    - Parm — ParamType
    - X=c — X=cType
    - Y> — Y>Type
    - Y< — Y<Type
    - Y≥ — Y≥Type
    - Y≤ — Y≤Type
  - COLR
    - Blue — BlueG_
    - Omg — OrangeG_
    - Grn — GreenG_
  - GMEM
    - Sto — StoGMEM_
    - Rcl — RclGMEM_
- DYNA
  - On — D_SelOn_
  - Off — D_SelOff_
  - Var — D_Var_
  - TYPE
    - Y= — Y=Type
    - r= — r=Type
    - Parm — ParamType
- TABL
  - On — T_SelOn_
  - Off — T_SelOff_
  - TYPE
    - Y= — Y=Type
    - r= — r=Type
    - Parm — ParamType
  - Blue — BlueG_
  - Omg — OrangeG_
  - Grn — GreenG_
- RECR
  - SEL+C
    - On — R_SelOn_
    - Off — R_SelOff_
    - Blue — BlueG_
    - Omg — OrangeG_
    - Grn — GreenG_
  - TYPE
    - an — anType
    - an+1 — an+1Type
    - an+2 — an+2Type
  - n.an..
    - n — n
    - an — an
    - an+1 — an+1
    - bn — bn
    - bn+1 — bn+1
- SYBL
  - · — ·
  - " — "
  - ~ — ~
  - * — *
  - / — /
  - # — #

[OPTN]key

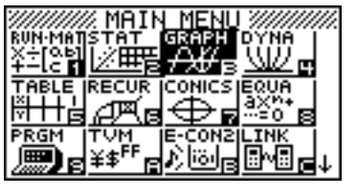
- LIST
  - List — List_
  - L→M — List →Mat(
  - Dim — Dim_
  - Fill — Fill(
  - Seq — Seq(
  - Min — Min(
  - Max — Max(
  - Mean — Mean(
  - Med — Median(
  - Sum — Sum_
  - Prod — Prod_
  - Cuml — Cuml_
  - % — Percent_
- MAT
  - Mat — Mat_
  - M→L — Mat →List(
  - Det — Det_
  - Trn — Trn_
  - Aug — Augment(
  - Idn — Identity_
  - Dim — Dim_
  - Fill — Fill(
- CPLX
  - i — i
  - Abs — Abs_
  - Arg — Arg_
  - Conj — Conjg_
  - ReP — ReP_
  - ImP — ImP_
- CALC
  - Solve — Solve(
  - d/dx — d/dx(
  - d2/dx2 — d2/dx2(
  - ∫dx — ∫(
  - FMin — FMin(
  - FMax — FMax(
  - Σ(— Σ(
- STAT
  - x^ — x^
  - y^ — y^
- COLR
  - Omg — Orange_
  - Grn — Green_
- HYP
  - sinh — sinh_
  - cosh — cosh_
  - tanh — tanh_
  - sinh-1 — sinh-1_
  - cosh-1 — cosh-1_
  - tanh-1 — tanh-1_
- PROB
  - X! — !
  - nPr — P
  - nCr — C
  - Ran# — Ran#
  - P(— P(
  - Q(— Q(
  - R(— R(
  - t(— t(
- NUM
  - Abs — Abs_
  - Int — Int_
  - Frac — Frac_
  - Rnd — Rnd
  - Intg — Intg_
- ANGL
  - ° — °
  - r — r
  - g — g
  - °' " — □
  - Pol(— Pol(
  - Rec(— Rec(
- ESYM
  - m — m
  - μ — μ
  - n — n
  - p — p
  - f — f
  - k — k
  - M — M
  - G — G
  - T — T
  - P — P
  - E — E
- PICT
  - Sto — StoPict_
  - Rcl — RclPict_
- FMEM
  - fn
    - f1 — f1
    - f2 — f2
    - f3 — f3
    - f4 — f4
    - f5 — f5
    - f6 — f6
- LOGIC
  - And — _And_
  - Or — _Or_
  - Not — Not_

Notes:

OTHER ICONS

Graph

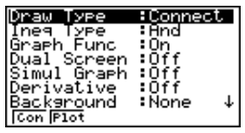
Graph [3] Stores graphs, up to 20 functions, that you use regularly or 'families' of graphs where relationships and special features can be viewed.

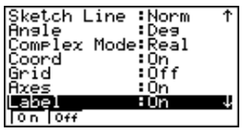


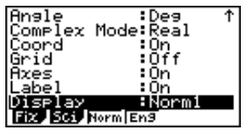
All of the **Function** key menus, such as **Trace, Zoom, V-Window, Sketch, Graphical Solutions** and **Graph - Text** are available. It is also where you can view Graph - Graphs and Graph - Table split screens. The screen is split vertically, giving very good views of what you have chosen to see.

Set Up

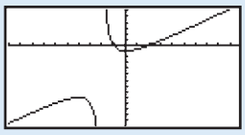
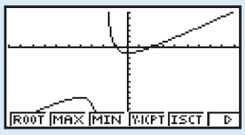
KEY	  



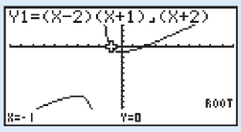
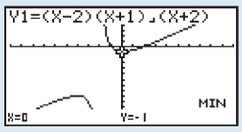
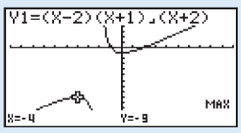
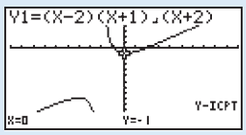
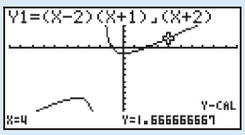
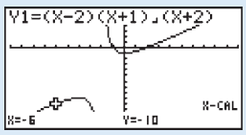




Example

Collate information about the function $y = \frac{(x-2)(x+1)}{(x+2)}$	*Result*
Store the expression in position Y1 (X,θ,T - 2) (X,θ,T + 1) $a^b/_c$ (X,θ,T + 2) *then* EXE	
Draw the graph F6 *or* EXE	
For selection SHIFT F5	

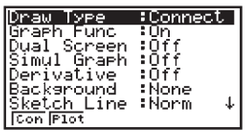
From the above find the...

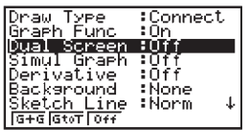
Root/s SHIFT F5 F1 ▶		*Minimum* SHIFT F5 F3	
Maximum SHIFT F5 F2		*Y-intercept* SHIFT F5 F4	
Y-value calculations SHIFT F5 F6 F1		*X-value calculations* SHIFT F5 F6 F2	

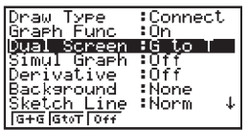
Graph [3] re-visited

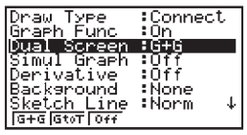
The 'Graph' mode can also have **Graph - Graph or Graph - Table**. You can 'toggle' between the table and the graph.

KEY	SHIFT MENU	F2	F1
		Change dual screen to 'G to T'	Change dual screen to 'G & G'







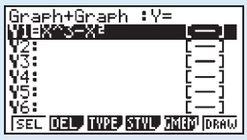


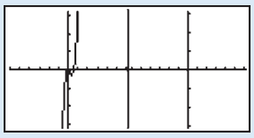
Graph - Graph

The Left split screen is the Main screen and the Right split screen is where the 'zooming' in/out will be drawn. Hence, the original graph can be seen as you manipulate the Right screen, for the desired view.

Example

Graph $y=x^3 - x^2$ and view the x-intercepts closely.





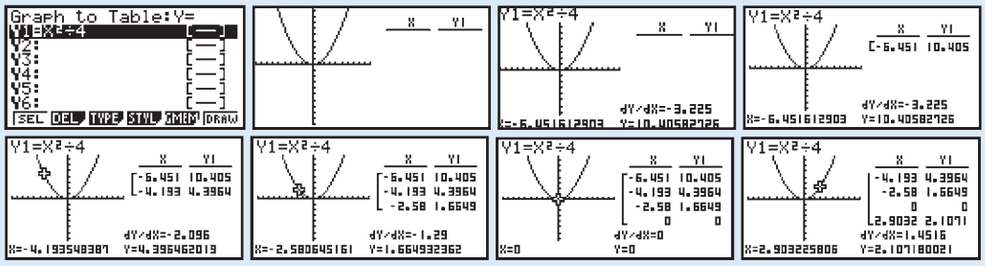
Graph - Table

The Left split screen is the Main screen and the Right split screen is where the x-, y-, and derivative values are displayed as you 'Trace' the graph. When **[EXE]** is pressed the table values will be generated. These Table values can be stored as a List ifdesired for further investigation.

Example

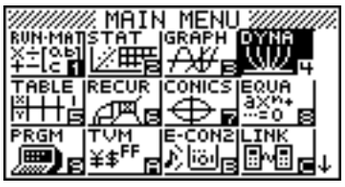
Graph $y=x^2 \div 4$ and compare table values to graph values.

Press [EXE] to get the table entry.

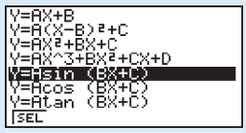


Dyna

Dyna [4] 'Dynamic Graphs' can be used to illustrate the changing shapes of selected functions and varying one of the coefficients in the equation and view the changing nature of the 'family of graphs'.



Example

Investigate the differing shape of Y = Asin (1x + 0)	*Result*
Make sure the V-Window [SHIFT] [F3] is appropriate to view the graph(s). *Select the graph type required* [F5] *(B-In)* [▼] [▼] [▼] [▼] [EXE]	 

cont. on next page

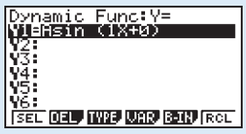
OTHER ICONS

Dyna cont.

Store the expression

[▶] [▶] [▶] [▶] *to override "B"* [1] [▶] [▶] *to override "C"*

[0] *then* [EXE]



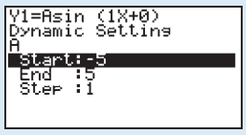
Change the variable

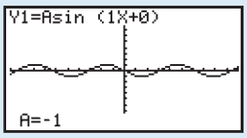
[F4] *[VAR]* [3] [EXE]

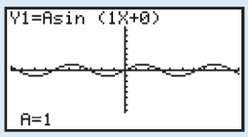
Set the dynamic range

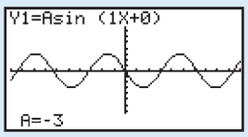
[F2] *[SET]* [-] [5] [EXE] , [5] [EXE] *then* [EXIT]

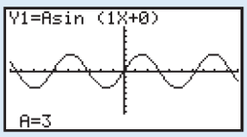
[F6] *to draw graph*







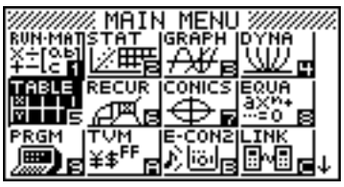




Prior to you seeing the dynamic graph a message will come on the screen (left). This is where the calculator generates the differing views in relation to the coefficient starting, finishing and pitch values that has been chosen for the displaying of the 'family of graphs'.

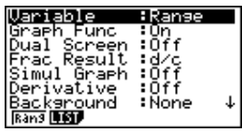
Table

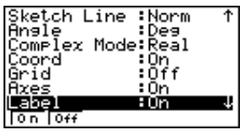
Table [7] The use of the 'Table' mode can create lists such as a sequence or table of values generated by a given relationship, a graph of the table or a table and a dual graph of the table values and table. You can 'toggle' between the table and the graph. Setting the calculator up for the different screen displays is through **SETUP**.

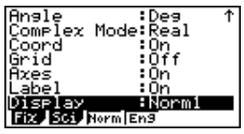


Choose your settings by scrolling with the up and down **REPLAY** keys.

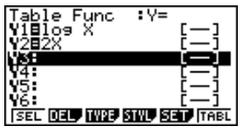
KEY	  



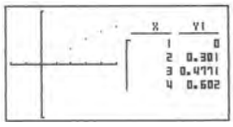


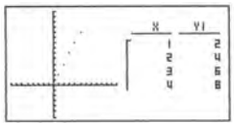


Define the relations



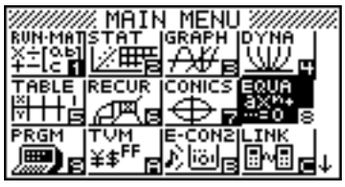
The Graph and Text Screens given



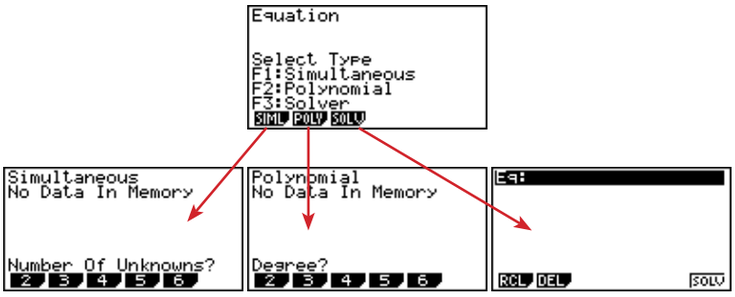


Equations

Equations [8] The use of this mode can have you solving simultaneous equations **[F1]**, up to 6 unknowns or solving quadratic and cubic equations and other polynomials (up to degree 6) **[F2]** and the Equation Solver **[F3]**. This mode of operation is self explanatory and can be used to investigate Linear Programming, or the relationship between 'roots' of polynomial equations.



Equations cont.

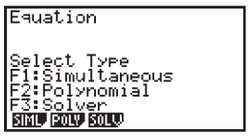


Simultaneous Equations 2 Equations–2 Unknowns TO 6 Equations–6 Unknowns

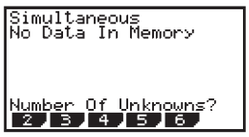
The calculator can solve simultaneous linear equations up to 6 unknowns, any other linear equation systems > 6 unknowns should be solved in the **RUN-MAT** icon from the **MAIN MENU** using matrices.

The calculator can solve systems of equations in the form:

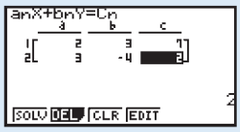
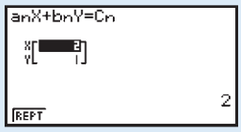
ax + by = c
dx + ey = f



KEY 



Example

Solve $2x + 3y = 7$ $3x - 4y = 2$	*Result*
Enter the coefficients of the equation 2 EXE 3 EXE 7 EXE 3 EXE - 4 EXE 2 EXE *then* F1 *or* EXE *to solve the equation*	 

For solving 2 simultaneous equations - 6 simultaneous equations enter the appropriate number of unknowns via the **Function** key and then enter the coefficients of each equation and solve.

Solving Polynomial Equations

The calculator can solve quadratic and cubic equations and other polynomials up to degree 6, any other polynomials of degree > 6 should be solved in the **GRAPH** icon from the **MAIN MENU.**

KEY 

A quadratic equation: $ax^2 + bx + c = 0$.

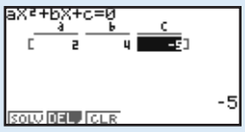
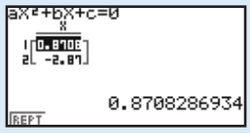
Example

Solve $x^2 - 3x + 2 = 0$	*Result*
Enter the coefficients of the equation 1 EXE - 3 EXE 2 EXE *then* F1 *or* EXE *to solve the equations*	 

cont. on next page

Solving Polynomial Equations cont.

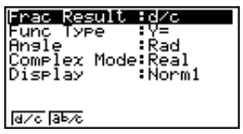
Example 2

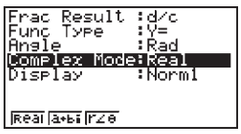
Solve $2x^2 + 4x - 5 = 0$	*Result*
Enter the coefficients of the equation [2] [EXE] [4] [EXE] [-] [5] [EXE] *then* [F1] *or* [EXE] *to solve the equations*	 

KEY	

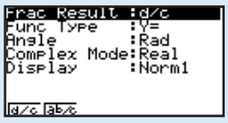
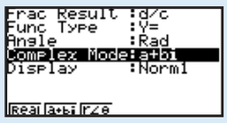
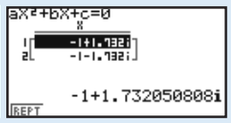
Note:
In solving the polynomial equations the solutions can be displayed in polar and rectangular format if the solutions are complex.

*Use **SETUP** and then scroll down to change the settings, as required by pressing the appropriate **Function** key(s).*

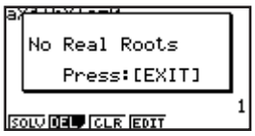



Example 3

Solve $x^2 + 2x + 4 = 0$	*Result*
Change the format of complex mode [SHIFT] [MENU] [▼] [▼] [▼] [F2] [EXIT]	 
Enter the coefficients of the equation [2] [EXE] [4] [EXE] [-] [5] [EXE] *then* [F1] *or* [EXE] *to solve the equations*	 

Note:
The following error message is due to incorrect mode settings.

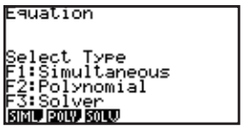


A cubic equation: $ax^3 + bx^2 + cx + d = 0$.
A quartic equation format: $ax^4 + bx^3 + cx^2 + dx + e = 0$.
A quintic equation format: $ax^5 + bx^4 + cx^3 + dx^2 + ex + f = 0$, etc.

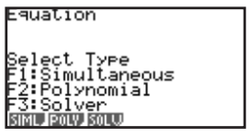
For solving the appropriate degree polynomial, enter the appropriate degree via the **Function** key and then enter the coefficients of each equation and solve.

Solving Other Types of Equations

Using the Solver in **EQUA**tion mode:




Using the Solver tool type in the equation without rearranging and solve using **[F6]** or **[EXE].**



KEY	 **SOLV**er

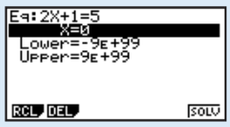
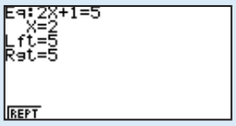
Enter in the equation.

You are 'greeted' with the screen shown above. This is where you enter in the equation and solve the equation with the information about the 'known' variable values and solve for the **'unknown'** variable.

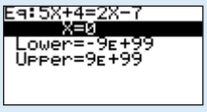
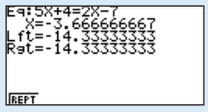
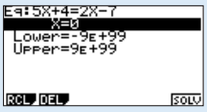
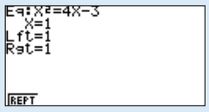
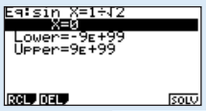
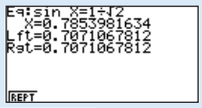
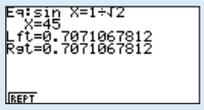
cont. on next page

Solving Other Types of Equations cont.

Example

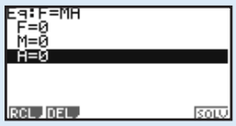
Solve 2x + 1 = 5	Result
Enter the equation [2] [X,θ,T] [+] [1] [SHIFT] [.] [5] then [EXE] to store	 
[F6] to solve **Note**: You are able to use any letter of the alphabet as the 'dummy' variable in the equation, using the [ALPHA] and [SHIFT] keys and corresponding key.	

Other Examples

Solve 5x + 4 = 2x - 7	Result
[5] [X,θ,T] [+] [4] [SHIFT] [.] [2] [X,θ,T] [-] [7] then [EXE] to store then [F6] to solve	 
Solve $x^2 = 4x - 3$	**Result**
[X,θ,T] [x^2] [SHIFT] [.] [4] [X,θ,T] [-] [3] then [EXE] to store then [F6] to solve	 
Solve $\sin x = 1/\sqrt{2}$	**Result**
[sin] [X,θ,T] [SHIFT] [.] [1] [÷] [SHIFT] [x^2] [2] then [EXE] to store then [F6] to solve	  

Note: *there are TWO solutions to a quadratic equation and using Solver will only find one solution. The calculator will display only one solution (the PRINCIPAL) in the radian or degree setting.*

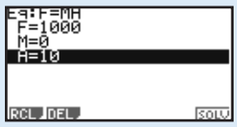
Example 2

Force = Mass × Acceleration i.e. F = MA, find the value of the mass of the object, if the Force = 1000 Newtons and the acceleration = 10 ms^{-2}. Given that F = MA and F=1000, A=10 find M.	Result
Enter the equation and set all the variables to 0 [ALPHA] [tan] [SHIFT] [.] [ALPHA] [7] [ALPHA] [X,θ,T] then [EXE] to store [0] [EXE] [0] [EXE] [0] [EXE] Variables are all set to 0	

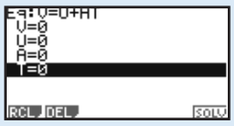
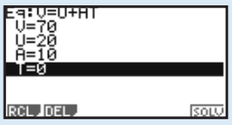
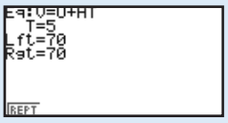
cont. on next page

Solving Other Types of Equations cont.

Example 2 cont.

Change the known variables to those defined in the problem [1] [0] [0] [0] [EXE] [0] [EXE] [1] [0] [EXE]	
Move the 'cursor' so that it is 'sitting' over the top of the variable that you want to calculate the answer to, in this case 'M'. *then* [F6] *[SOLV]*	

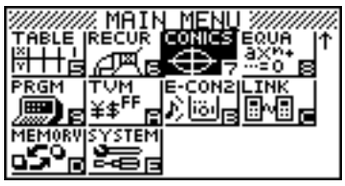
Example 3

Given that V=U+AT and U=20 ms^{-1}, V=70 ms^{-1} and A=10 ms^{-2}, find T.	*Result*
Enter the equation [ALPHA] [2] [SHIFT] [.] [ALPHA] [1] [+] [ALPHA] [X,θ,T] [ALPHA] [÷] *then* [EXE] *to store*	
Set all the variables as per the equation [7] [0] [EXE] [2] [0] [EXE] [1] [0] [EXE] [0] [EXE]	
Move the 'cursor' so that it is 'sitting' over the top of the variable that you want to calculate the answer to, in this case 'T'. *then* [F6] *[SOLV]*	

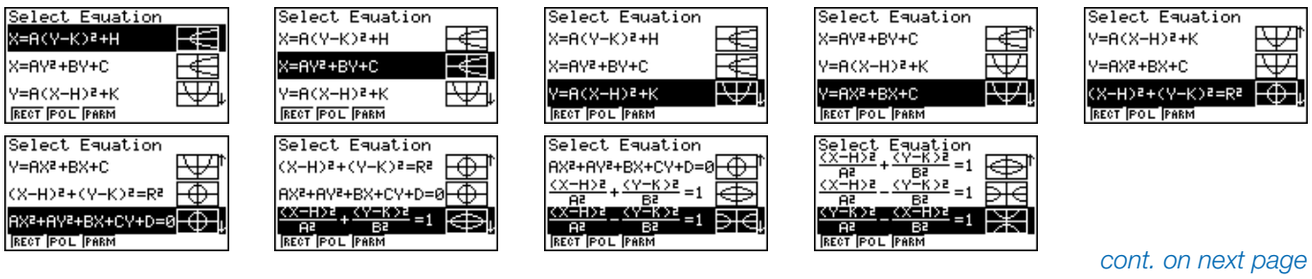
Note:
Any algebraic or trigonometric equation can be solved in this area of the calculator ***BUT*** *only one solution is found at any one time (based on the Newton-Raphson Method), hence multiple solutions to equations should be solved in the* ***GRAPH*** *icon from the* ***MAIN MENU****.*

Conics

Conics [7] The use of this mode can see the user investigate the properties of the conics sections. Varying the expressions for standard conic equations the student can investigate the conics and their associated equations and properties.



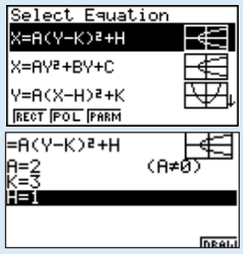
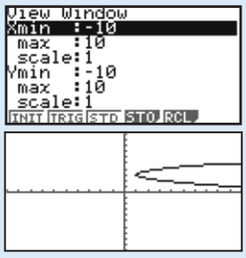
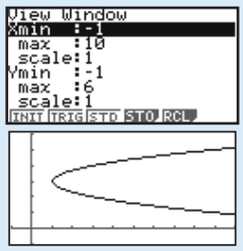
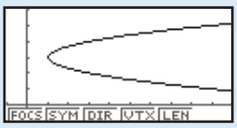
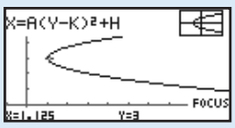
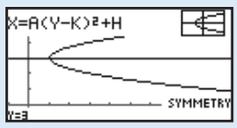
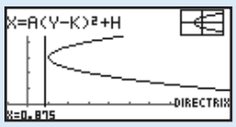
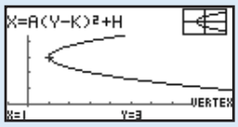
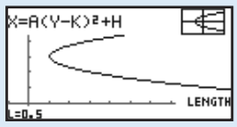
Use the arrow keys to select the conic type required. Note also that the different selections are for various ways of drawing and finding focal points, directrix, asymptotes and centres of the parabola, ellipse, circle and hyperbola. You are also able to select rectangular, polar or parametric formats for each of the conic sections.



cont. on next page

Conics cont.

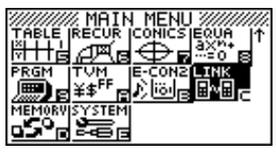
Example

Find the directrix, symmetry line, length, vertex and the focal points for the parabola $x = 2(y - 3)^2 + 1$	*Result*
Enter in the appropriate coefficients [2] [EXE] [3] [EXE] [1] [EXE]	
Make sure that the domain and range are set up adequately, via the V-Window. [SHIFT] [F3] *As a 'rule of thumb' start with the V-Window set at the STD view by pressing the* [F3] *key, view the graph and then change the x- and y- settings to suitable values.*	
In this case [-] [1] [EXE] [1] [0] [EXE] [1] [EXE] [-] [1] [EXE] [6] [EXE] [1] [EXE] *then* [EXIT] *and* [F6] *[DRAW]*	
The G-Solve tools can be employed [SHIFT] [F5] *for each aspect of the conic section you require*	  *Focus*  *Symmetry*  *Directrix*  *Vertex*  *Length*

Note:
The other conic equation types behave in a similar fashion to the example worked above.

Link

Link [C] The 'Link' mode is where communication with a personal computer can be made, a printer for printing screen images or transmitting and receiving data or pictures from one calculator to another. Items can be selected one at a time or in groups or the entire calculator memory can be 'relocated'.

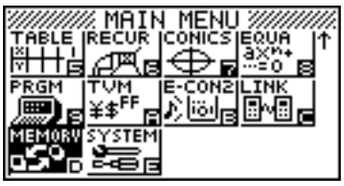


Note:
The SB-62 cabling (3-pin) or the USB (5 pin) cabling are required for the data transfer.

OTHER ICONS

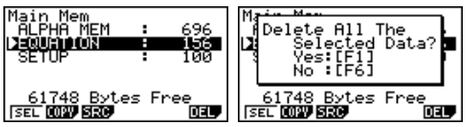
Memory Manager

Memory Manager [D] The calculator memory use can be checked and modified by the user. Each section of the calculators 'storage' memories can be deleted or copied singularly or 'totally' **RESET** or backed up. You can search for particular files using the search function **[F3].**



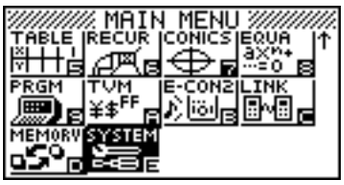
KEY	

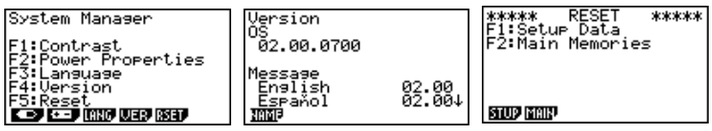
To select view the **MEMORY USAGE**, press **[F1]** for the Main Memory. Then use the down arrow followed by **[F1]** to reset the storage space memory to zero. You will see a message screen giving you a choice. Press either [**F1]** for **'Yes'** or **[F6]** for **'No'**.



System

System [E] The calculator operation and use can be checked and modified. Each section of the calculator's memory 'storage' can be deleted either singularly or 'totally' **RESET.**





Contrast

The light that 'hits' the screen can be reduced or the intensity of the colour on the screen can be made lighter or darker to suit the user.

Power Properties

Power properties setting to 10 or 60 minutes to power off.

Language

Select the language to be used on the calculator.

Version

Operating system version number – linked to version releases from CASIO®.

Reset

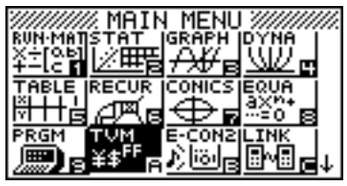
Resetting the graphic calculator to the predetermined manufacturers specifications (as set when you initially placed in the batteries).

Resetting the calculator serves three main purposes:

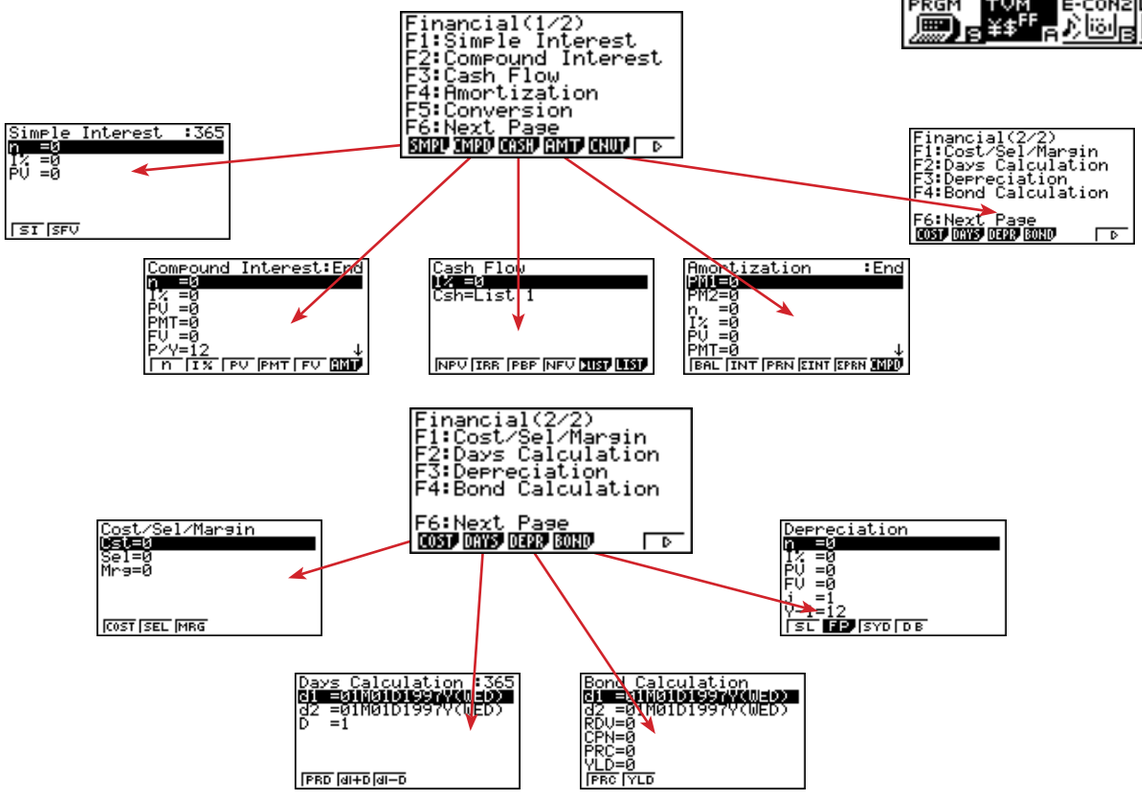
1. It clears any previous operations that the current user may not be familiar with or want to use.
2. It returns the calculator to its initial default settings.
3. Viewing and deleting specific areas of the calculator memory, usually in this case to 'free up' memory.

To select view the **MEMORY USAGE**, press **[F1]** for the Main Memory. Then use the down arrow followed by **[F1]** to reset the storage space memory to zero. You will see a message screen giving you a choice. Press either [**F1]** for **'Yes'** or **[F6]** for **'No'**.

TVM



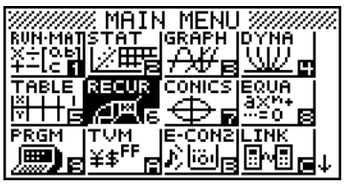
TVM [A] In this icon economic and accounting formulae can be selected and used to calculate various time, value or money problems.

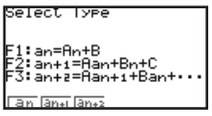


Notes:

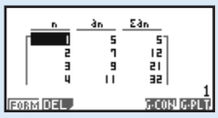
MISCELLANEOUS FUNCTIONS

Sequence and Series [in RECUR]



KEY	MENU 6	F3	F1
RESULT			

Example

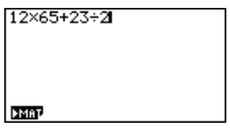
Find the first 10 terms of the sequence <a_n> = <2n + 3>	*Result*
2 F1 + 3 *then* EXE *to store*	
Set the values for 'n' F5 *[SET]* 1 EXE 1 0 EXE *then* EXIT *Select TABLe and scroll to see the remaining values of the sequence* F6 *[TABL]* ▼ ▲ *Giving the answer <a_n> = <5, 7, 9, 11, 13, 15, 17, 19, 21, 23, ...>*	 
Note: *the third column on the worksheet has a* Σa_n *this is accessed through the* ***SET UP*** *via* ***[SHIFT] [MENU]*** *and adjusting the appropriate settings for Sigma* Σ *display to be on* ***[F1]****.*	

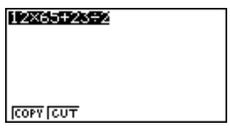
CLIP and PASTE

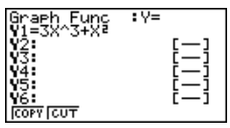
Cutting and pasting from a document (via emulator) or from a particular icon on the hand-held FX9750GII and pasting it into another working area.

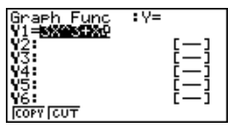
KEY	SHIFT 8 9

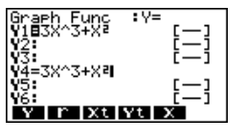
1. Copy and paste from a document
2. Working to be transferred to another area of the calculator using **COPY/CUT** and **PASTE**.
   After the expression or equation is entered access **CLIP [SHIFT] [8]** and use the right (or left) replay arrow to highlight the required text to be copied or cut, press **[EXE]** then move to the area for pasting the copied text to be pasted by accessing **PASTE [SHIFT] [9]**.









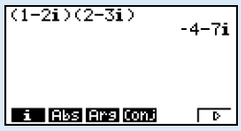
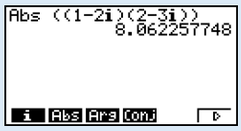
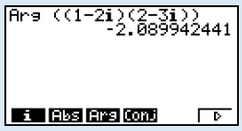


Complex Numbers [in RUN-MAT]

You may have noticed the calculator can provide complex number answers, for example when finding the roots to equations where the graph does not 'cut' the x-axis. Here the calculator that performs complex number calculations in either a + ib form or polar form (lzl and arg z).

KEY	OPTN F3

Example

Simplify (1 - 2i)(2 - 3i) and change the answer to polar form	*Result*
Key in the expression OPTN F3 (1 - 2 F1) (2 - 3 F1) EXE	
Change to polar form ▶ *to insert* F2 *[Abs]* (▼) EXE	
▶ *to insert* DEL F3 *[Arg]* EXE	

Answer: -4 - 7i and 8.06 cis (-2.09) (2 d.p.)

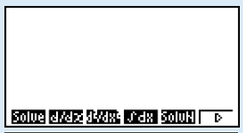
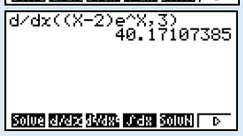
The real part and imaginary parts of the complex number can be separated, conjugates can be found and of course the complex number can be treated as a coordinate point for graphical representations.

Differentiation [in RUN-MAT]

The calculator can perform differentiation at any point and draw any derived function required.

KEY	OPTN F4

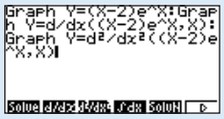
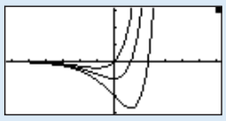
Example

Evaluate the slope of the curve f(x) = (x - 2)e^X at x = 3	*Result*
Key in the expression ***Note:*** *A comma is required then the x-value* OPTN F4 F2 (X,θ,T - 2) SHIFT ln X,θ,T , 3) EXE	 

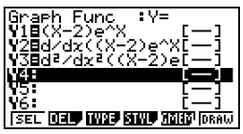
cont. on next page

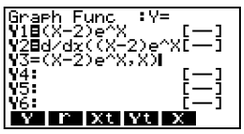
Differentation [in RUN-MAT] cont.

Example cont.

Drawing the function f(x) = (x-2)e^X and its first and second derivatives. Comment on the relationships between the graphs drawn.	*Result*
Enter the function SHIFT F4 *[SKTCH]* F5 *[GRPH]* F1 *[Y=]* (X,θ,T - 2) SHIFT ln X,θ,T SHIFT VARS F6 F5	
Enter the first derivative SHIFT F4 *[SKTCH]* F5 *[GRPH]* F1 *[Y=]* OPTN F4 F2 (X,θ,T - 2) SHIFT ln X,θ,T , X,θ,T) SHIFT VARS F6 F5	 
Enter the second derivative SHIFT F4 *[SKTCH]* F5 *[GRPH]* F1 *[Y=]* OPTN F4 F3 (X,θ,T - 2) SHIFT ln X,θ,T , X,θ,T) SHIFT VARS F6 F5 *then* EXE	

This can also be done in **GRAPH** mode by storing each of the functions, namely f(x), f′(x) and f″(x) in the **Y1, Y2** and **Y3** 'spaces' respectively. [Remember to place the **,X)** after the first and second derivative.]

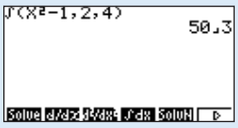
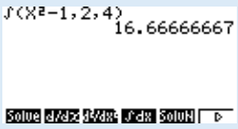




Integration [in RUN-MAT]

Integration can be displayed as the definite integral value only or the graph of the required integral and the definite integral value. The calculator uses Simpsons Rule to evaluate definite integrals. If you do not specify the number of steps used by Simpsons Rule, then the calculator will use 512 steps in the calculation of the request.

Example

Find the integral of y = x² - 1 between x = 2 and x = 4.	*Result*
Integral value only OPTN F4 F4 X,θ,T x^2 - 1 , 2 , 4) *then* EXE	 

cont. on next page

Integration [in RUN-MAT] cont.

Example cont.

Do not forget to set up the Domain and Range values through the View Window.

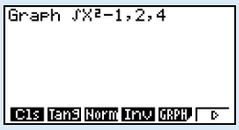
[SHIFT] [F3] , [-] [5] [.] [1] [EXE] [7] [.] [5] [EXE]

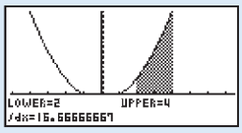
[1] [EXE] [▼] [-] [5] [EXE] [1] [5] [EXE] [EXIT]

Graph and integral value

[SHIFT] [F4] , [F5] [F5] [X,θ,T] [x^2] [-] [1] [,] [2] [,]

[4] *then* [EXE]





Piecewise Functions [in RUN-MAT]

Piecewise functions can be entered in the usual way and then the domain values for each can be defined and finally drawn.

Example

Draw $f(x) = \begin{cases} x & , x < -1 \\ x^2 & , -1 < x < 1 \\ |x-2| & , 1 < x < 3 \\ \sqrt{x} & , x > 3 \end{cases}$

Result

Key in the desired functions, separating each with a colon ' : ' and defining the interval using ' [' and '] '.

[SHIFT] [F4] [F5] [F1]

[X,θ,T] [,] [SHIFT] [+] [-] [1] [0] [,] [-] [1] [SHIFT] [-]

[SHIFT] [VARS] [F6] [F5] ,

[SHIFT] [F4] [F5] [F1]

[X,θ,T] [x^2] [,] [SHIFT] [+] [-] [1] [,] [1] [SHIFT] [-]

[SHIFT] [VARS] [F6] [F5] ,

[SHIFT] [F4] [F5] [F1]

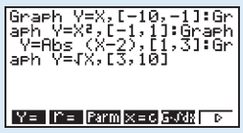
[OPTN] [F3] [F2] [(] [X,θ,T] [-] [2] [)] [,] [SHIFT] [+] [1]

[,] [3] [SHIFT] [-]

[SHIFT] [VARS] [F6] [F5] ,

[SHIFT] [F4] [F5] [F1]

[SHIFT] [x^2] [X,θ,T] [,] [SHIFT] [+] [3] [,] [1] [0] [SHIFT] [-]



cont. on next page

MISCELLANEOUS FUNCTIONS

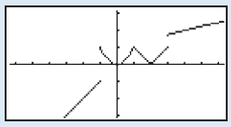
Piecewise Functions [in RUN-MAT] cont.

Example cont.

Set the V-Window to [INIT]

[SHIFT] [F3] [F1] [EXIT]

then [EXE]

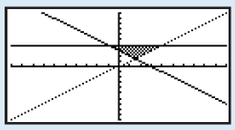
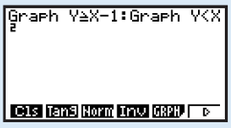
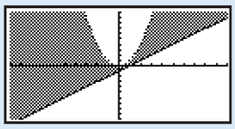
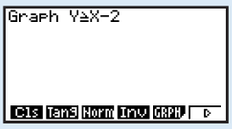
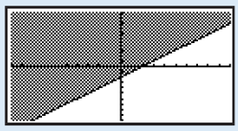


You are able to trace the 'different parts' of a Piecewise Function using **[SHIFT] [F1],** then the ▶ ◀ replay arrows**.**

Inequalities [in RUN-MAT]

Finding regions that satisfy constraints as used in linear programming.

Example

Function	*Graph*
	
	
	

Make sure that you have an appropriate View-Window to see the graphs drawn.

By separating each graph by a colon ':' the calculator generates them as a 'collective'. Tracing each to find vertices etc is activated in the usual way, i.e. **[SHIFT] [F1]** and then ▼ ▲ arrows to trace the graph and the ▶ ◀ to move from one graph to another.

Algebraic substitution – numeric [in RUN-MAT]

This activity shows how the calculator can be used to substitute numerical values into algebraic expressions. Algebraic substitution is where an independent numerical variable, usually x, is substituted into an equation for a dependent variable, usually y.

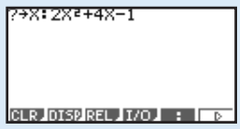
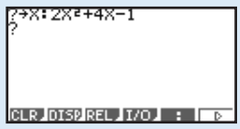
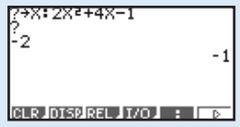
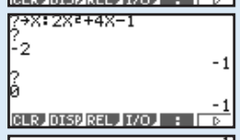
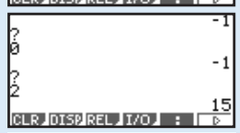
To have '?' and ':' statements:

KEY	SHIFT VARS F4	**RESULT**	**"?"**
KEY	SHIFT VARS F6 F5	**RESULT**	**":"**

cont. on next page

Algebraic substitution – numeric [in RUN-MAT] cont.

Example

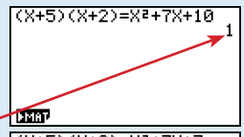
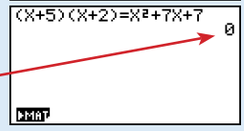
Calculate the value of the following when x = -2, 0, 2 and 4, in the expression $2x^2 + 4x - 1$.	*Result*
Enter the expression [SHIFT] [VARS] [F4] [→] [X,θ,T] [SHIFT] [VARS] [F6] [F5] [2] [X,θ,T] [x^2] [+] [4] [X,θ,T] [-] [1] *then* [EXE] *A '?' will display, this is the calculators way of saying, "Enter in a number."*	
Enter in the number [-] [2] *then* [EXE] *the answer -1 is displayed, the calculator has done the calculation:* $2\times(-2)^2 + 4\times(-2) - 1 = -1$	
[EXE] *this brings up the '?' again* [0] *then* [EXE] *Repeat the above sequence, calculating the expression of $2x^2 + 4x - 1$ for each of the x-values required.*	   

Note:
Differentiation d/dx and d^2/dx^2 is via ***[SHIFT] [OPTN] [F4]*** *for* ***CALC****ulus.*

Factorisation checking [in RUN-MAT]

Checking that you have factorised (put into brackets) or expanded (removed the brackets) correctly:
The 'calculator's logic' will return a **'0'** if incorrectly done or a **'1'** if correctly done.
As this calculator is a 'numerical manipulator' and **NOT** a 'symbolic manipulator' the student MUST learn how **to factorise (put into brackets)** or expand **(remove from brackets)**.

Example

Expand (x + 5)(x + 2)	*Result*
Enter in the equation in bracketed and the expanded form [(] [X,θ,T] [+] [5] [)] [(] [X,θ,T] [+] [2] [)] [SHIFT] [.] [X,θ,T] [x^2] [+] [7] [X,θ,T] [+] [1] [0] *then* [EXE] *The result 1 indicates that it is correctly expanded.* *The result 0 indicates that it is incorrectly expanded.*	 

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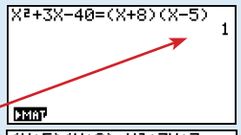
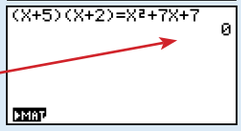
MISCELLANEOUS FUNCTIONS

Factorisation checking [in RUN-MAT] cont.

Example 2

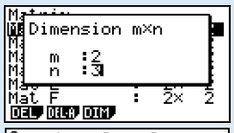
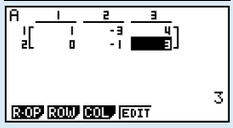
Factorise $x^2 + 3x - 40$	*Result*
Enter in the equation in bracketed and the expanded form [X,θ,T] [x^2] [+] [3] [X,θ,T] [-] [4] [0] [SHIFT] [.] [(] [X,θ,T] [+] [8] [)] [(] [X,θ,T] [-] [5] [)] *then* [EXE] *The result 1 indicates correct factorisation.* *The result 0 indicates incorrect factorisation.*	 

Matrix/Matrices [in RUN-MAT]

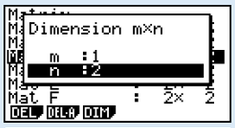
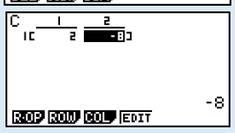
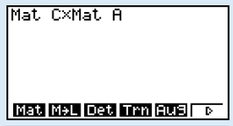
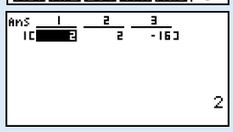
This area of the calculator utilises all of Matrix addition, subtraction and multiplication properties. Transformation Geometry can be investigated or linear programming, up to 8 variables i.e. A matrix size of order 8 x 8. You can edit up to 26 different matrices of differing order and there is an automatic space for the answer matrix.

Define the matrices in the usual way, firstly its order rows x columns. Then enter the matrix values. You 'do' the operations in **RUN-MAT** mode. Via **[F1]** define the matrix dimensions, enter in the values of each matrix then to +, - or × open **OPTN** then **[F2]** for the Matrix operations.

Example

Calculate $[2 \quad -8] \times \begin{bmatrix} 1 & -3 & 4 \\ 0 & -1 & 3 \end{bmatrix}$	*Result*
Enter the dimensions into Mat A and then the first values [F1] [EXE] [2] [EXE] [3] [EXE] *Dimensions entered* [1] [EXE] [-] [3] [EXE] [4] [EXE] [0] [EXE] [-] [1] [EXE] [3] [EXE] *then* [EXIT]	 

Example cont.

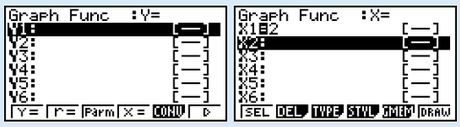
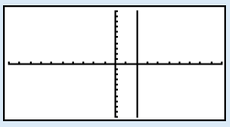
Enter the second dimensions into Mat C and then the second values [▼] [EXE] [1] [EXE] [2] [EXE] *Dimensions entered* [2] [EXE] [-] [8] [EXE]	 
Complete the calculation [EXIT] [EXIT] [OPTN] [F2] [F1] [ALPHA] [ln] [x] [F1] [ALPHA] [X,θ,T] *then* [EXE]	 

Linear programming with vertical lines: converting x = c to y = mx + c [in GRAPH]

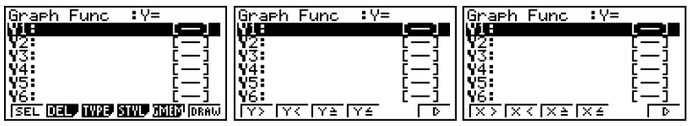
Note:
*When solving linear programming problems coordinates involved with vertical lines cannot be solved using **G-Solve**. Converting them to y = mx+c form can assist and give you access to **G-Solve**.*

When drawing any graphs make sure that the **V-Window** is appropriate to see the graphs that you will be drawing. **[SHIFT] [F3]**. Select **[F1]**, in this case for **INIT**ial conditions, as a starting point or use the domain and range values on the grid system that is given in the question to define the View-Window settings. Now use the **[EXIT]** or **[EXE]** key to go back to the Graph Func: window. Vertical lines x = c, found by menu trail: **[F3]** for **TYPE** then **[F4]** for x = c format.

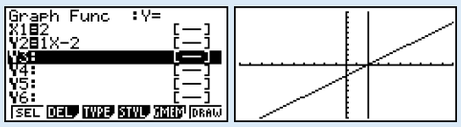
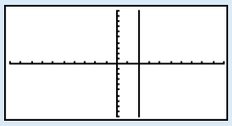
Example

Draw the graph x = 2	*Result*
Change Y= to X= and the store the equation [F3] [F4] [EXIT] [F1] *then* [2] [EXE] [F6] *or* [EXE] *to draw the graph*	 

In linear programming inequalities are required to find the 'feasible region' that satisfies the given constraints. You are able to draw inequalities with x ≥ or < or > or ≤ on the FX9750GII but finding intersection points involving vertical lines cannot be performed. You need to 'trick' the calculator into thinking that it is drawing a vertical line in the y = mx + c format.

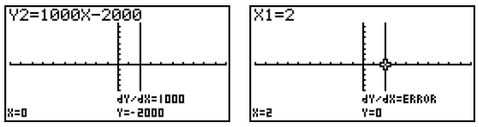
KEY		RESULT	

Example 2

Type into the 'Y2' space '1x – 2', then try y = 1000x – 2000.	*Result*
Y2=1x-2 [1] [X,θ,T] [-] [2] [EXE] *then* [F6]	
Y2=1000x-2000x [1] [0] [0] [0] [X,θ,T] [-] [2] [0] [0] [0] [EXE] *then* [F6]	

The latter produces a 'vertical line' very similar to x = 2 over this **Viewing window.**

But, you have essentially tricked the calculator into drawing a 'vertical line'. You can check that they are NOT the same by doing a **Trace – [SHIFT] [F1]** and using the up / down arrows to trace either x = 2 and y = 1000x – 2000 (or similar).



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MISCELLANEOUS FUNCTIONS

Linear programming with vertical lines: converting x = c to y = mx + c [in GRAPH] cont.

Example 2a

Problem: *Find the feasible region that satisfies the following constraints over the domain $0 \le x \le 25$ and range $0 \le y \le 25$:*
$x + y \le 15$ $\quad y \le 6$ $\quad 4x + y \le 24$ $\quad x \le 2$ $\quad y \le 2x$

Answer: *Rearranging to make y the 'subject' gives:*
$y \le 15 - x$ $\quad y \le 6$ $\quad y \le 24 - 4x$ $\quad x \le 2$ $\quad y \le 2x$

Becomes $y \le 1000x - 2000$

*The **V-Window** **[SHIFT] [F3]** becomes:*

Result

Then enter in the constraints and then draw them

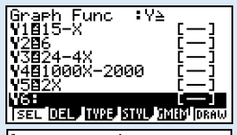
[F3] [F6] [F4] *Change Y= to Y ≤*

[1] [5] [-] [X,θ,T] [EXE] [6] [EXE] [2] [4] [-] [4]

[X,θ,T] [EXE] [1] [0] [0] [0] [X,θ,T] [-] [2] [0] [0]

[0] [EXE] [2] [X,θ,T] [EXE] *then* [F6] *to draw*

Note: *You cannot see the line y = 1000x – 2000.*

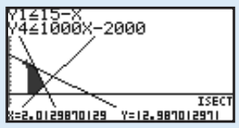


Find the intersection points (vertices) of the lines that intersect

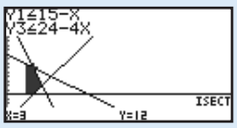
[SHIFT] [F5] *for G-Solve then*

[F5] *for [ISCT] (intersection)*

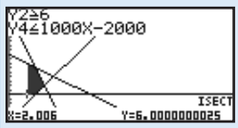
then select two lines at a time and generate the 5 intersection points.



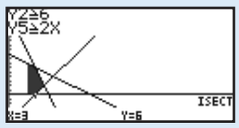
Y1 & Y4 gives (2 , 13)



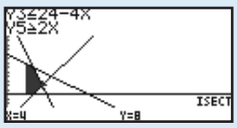
Y1 and Y3 gives (3 , 12)



Y2 and Y4 gives (2 , 6)



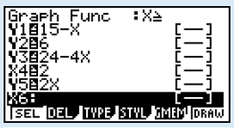
Y2 and Y5 gives (3 , 6)

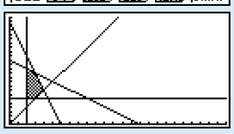


Y3 and Y5 gives (4 , 8)

Using the original equations:

$y \le 15 - x$ $\quad y \le 6$ $\quad y \le 24 - 4x$ $\quad x \le 2$ $\quad y \le 2x$ *gives:*

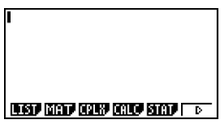




Note:
You can see the line x = 2 but G-Solve is not available for the vertical line x = 2. Some interpretation is required if the substitution line for x = c is not 'extremely' vertical on the region the constraints are drawn.

Factorials, Combinations and Permutations – Calculations [in RUN-MAT]

Combinations and Permutations – x!, ^nC_r and ^nP_r respectively

KEY		RESULT	
			  

cont. on next page

Factorials, Combinations and Permutations – Calculations [in RUN-MAT] cont.

Example

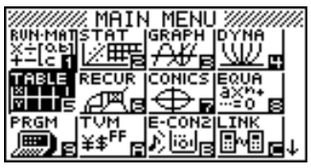
How many arrangements are there of 8 people standing in a line?	*Result*
Enter either [8] [F1] *or* [8] [F2] [8]	

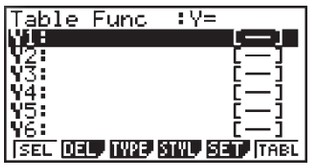
Example 2

How many ways can we choose a committee of 7 people from a group of 11 women and 8 men if there have to be 3 men and 4 women on the committee?	*Result*
Enter [1] [1] [F3] [4] *number of combinations of women* *Enter* [8] [F3] [3] *number of combinations of men* *Enter* [1] [1] [F3] [4] *x* [8] [F3] [3] *total number of ways of getting this committee*	

Table – of values [in TABLE]

A table of values, finding the numerical values from a given formula or function.





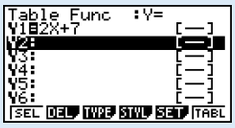
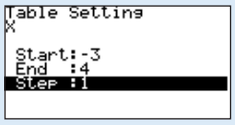
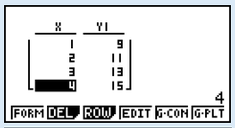
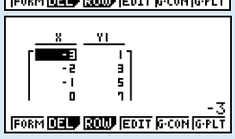
i.e. y = 3x + 1 can generate this table:

x	1	2	3
y = 3x+1	4	7	10

Or a sequence $<a_n> = 5n^2 - 4$

n	1	2	3
$y=5n^2-4$	1	16	41

Example

Generate a table of values for the relationship y = 2x +7 for -3 ≤ x ≤ 4	*Result*
Enter the relationship into the Y1 space [2] [X,θ,T] [+] [7] [EXE]	
Enter the setting for the variable 'x' [F5] [-] [3] [EXE] [4] [EXE] [1] [EXE] ***Note:*** *The pitch is, how large are your steps in moving from one x-value to the next.*	
[EXIT] *then* [F6] *for the table of values*	 

x	-3	-2	-1	0	1	2	3	4
y = 2x+7	1	3	5	7	9	11	13	15

MISCELLANEOUS FUNCTIONS

Conversions [in RUN-MAT]

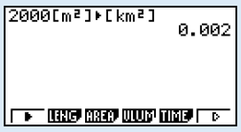
Converting between units of measure can be performed on the FX9750GII using the **CONV**ersion which is accessed via the **OPTN** key. The **[F1]** key ▶ is the conversion tool, note that it is on each conversion page.

	Length	Area	Volume	Time	Temperature	Velocity	Mass	Force	Pressure	Energy	Power
KEY	OPTN	F6	F1	F6	F6						
RESULT	LIST MAT CPLX CALC STAT ▷	CONV HYP PROB NUM ANGL ▷	▶ LENG AREA VLUM TIME ▷	▶ TMPR VELO MASS FORC ▷	▶ PRES ENGY PWR ▷						

Example

Convert 20 m/s into km/h (kilometres per hour).	*Result*
Enter [2] [0] [F6] [F3] *[VELO]* [1] *or* [EXE] *m/s selected*	
[F1] *[▶]* [F3] *[VELO]* [2] *or* [EXE] *km/h selected then* [EXE]	

Example 2

Convert the area of 2000 m² into km² .	*Result*
Enter [2] [0] [0] [0] [F3] *[AREA]* [2] *or* [EXE] *m² selected*	
[F1] *[▶]* [F3] *[AREA]* [4] *or* [EXE] *km² selected then* [EXE]	

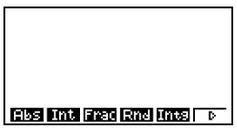
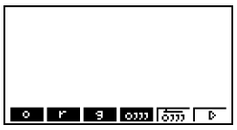
Commonly used keys

Some of the functions available as keys on a scientific calculator are not immediately obvious on a graphics calculator. Some searching is required in the **OPTN** menu.

Below is a table of some commonly used functions and where they are found on the graphics calculator. An example is shown for each.

cont. on next page

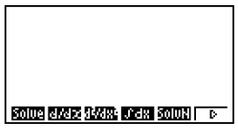
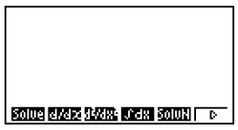
Commonly used keys cont.

FUNCTION	KEY	LOCATION	EXAMPLE
Factorials	x!	OPTN, F6, F3 (PROB), F1	
Permutations	$^{n}P_{r}$	OPTN, F6, F3 (PROB), F2	
Combinations	$^{n}C_{r}$	OPTN, F6, F3 (PROB), F3	
Random Numbers	Ran#	OPTN, F6, F3 (PROB), F4 then the desired random number generator.	
Absolute Value	Abs	OPTN, F6, F4 (NUMB), F1	
Integer Part of Answer	Int	OPTN, F6, F4 (NUMB), F2	
Fractional Part of Answer	Frac	OPTN, F6, F4 (NUMB), F3	
Degrees to Radians	°	OPTN, F6, F5 (ANGL), F1 (Ensure angle set to radians)	
Radians to Degrees	r	OPTN, F6, F5 (ANGL), F2 (Ensure angle set to degrees)	
Rectangular Coordinates to Polar Coordinates	Pol(	OPTN, F6, F5 (ANGL), F6, F1	

cont. on next page

MISCELLANEOUS FUNCTIONS

Commonly used keys cont.

Polar Coordinates to Rectangular	Rec(	OPTN, F6, F5 (ANGL), F6, F2	
Differentiation for first or second derivatives	d/dx or d^2/dx^2	OPTN, F4, F2 (CALC), F6, F2 or F3	
Integration for area under curves	∫dx	OPTN, F6, F5 (ANGL), F6, F4	

Notes:

Normal Distribution Analysis [in RUN-MAT]

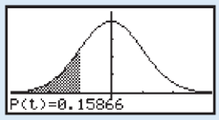
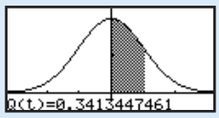
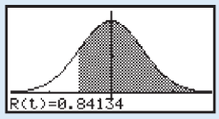
Although this could have been covered in the Statistics Chapter this topic needs to be treated separately.

KEY	OPTN	F6	F3	F6
RESULT				

This is the Normal Distribution (N.D.) 'menu'. **P(** calculates the N.D. shading from the left, **Q(** calculates the N.D. shading from the centre and **R(** calculates the N.D. shading from the right.

Graph Y = has the sequence: **[SHIFT]** **[F4]** **[F5]** **[F1]**

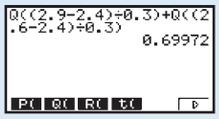
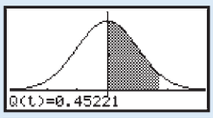
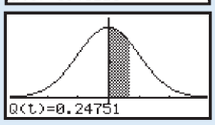
Example

Find the probabilities related to a z-score of -1.	*Result*
Graph Y=P(-1) SHIFT F4 F5 F1 OPTN F6 F3 F6 F1 - 1) EXE	
Graph Y=Q(1) SHIFT F4 F5 F1 OPTN F6 F3 F6 F2 1) EXE	
Graph Y=R(-1) SHIFT F4 F5 F1 OPTN F6 F3 F6 F3 - 1) EXE	

Excluding the 'Graph' will give the Normal Distribution probability value being displayed only.

Using the z-score transformation within the calculation on the calculator is also a good technique for the student to use.

Example 2

Scientists studying a species of fish find that adults have a mean weight of 2.4 kg and a standard deviation of 0.3 kg. *Find the probability a randomly selected fish weighs between 2.2 kg and 2.9 kg.*	*Result*
OPTN F6 F3 F6 F2 (2 . 9 - 2 . 4) ÷ 0 . 3) + F2 (2 . 6 - 2 . 4) ÷ 0 . 3) *then* EXE ***Note:*** *2.2 is on the left of the mean and has an equivalent probability value for 2.6, that is, Prob(2.2 < μ < 2.4) = prob(2.4 < μ < 2.6) giving Prob(2.2 < x < 2.9) = 0.6999 (4dp)*	 *As Graphs*  

NORMAL, BINOMIAL AND POISSON DISTRIBUTIONS

Normal Distribution Analysis [in RUN-MAT] cont.

Data that you have entered in the 'List' can also be used to model the data to be normally distributed, that is, assuming the data is normally distributed. By using the z-score transform and using '**μ**' and '**σ**' generated from the data in the list will be used to do the appropriate normal distribution calculations.

Enter the data into a list space and then generate the summary statistics associated with the data. Make a note of the required information and in **RUN-MAT** mode generate the desired calculations based on the Normal Distribution.

Example 3

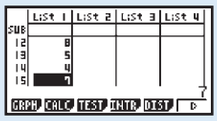
Enter the following data and assuming N.D. find the probability that a score of 5 or more is achieved.

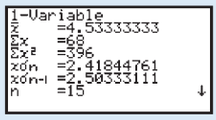
1	1	4	5	7	8	4	
1	2	4	7	8	5	4	7

Result

Enter the data into list 1

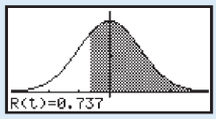
[1] [EXE] [1] [EXE] [4] [EXE] [5] [EXE] [7] [EXE] [8] [EXE]
[4] [EXE] [1] [EXE] [2] [EXE] [4] [EXE] [7] [EXE] [8] [EXE]
[5] [EXE] [4] [EXE] [7] [EXE] *then* [F2] *[CALC]* [F1] *[1VAR]*





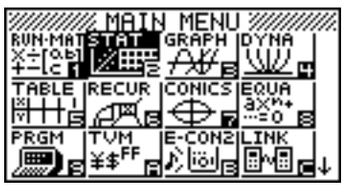
In RUN-MAT mode, complete the desired (1 variation) statistical calculations. Required Prob(x > 3) = Prob((3 - 4.533)/2.418) using the z-score transformation.

[SHIFT] [F4] [F5] [F1] , [OPTN] [F6] [F3] [F6] [F3]
[(] [3] [-] [4] [.] [5] [3] [3] [3] [)] [÷] [2]
[.] [4] [1] [8] [)] *then* [EXE]

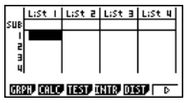


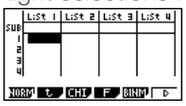
Prob(x > 3) = 0.7370 (4 d.p.)

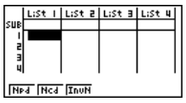
Normal Distribution Analysis [in STAT]

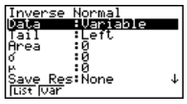


Left, Central and Right selections for Inverse Normal calculations in **STAT** mode.







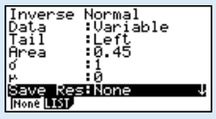


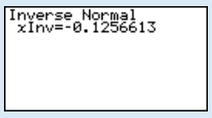
Example

Find the values of k such that Prob(Z < k) = 0.45

Result

[F5] [F1] [F3] [▼] [F1] [▼] [0] [.] [4]
[5] [EXE] *then* [EXE]



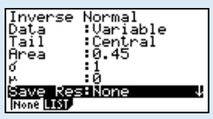


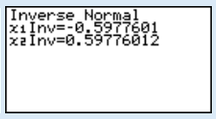
Example 2

Find the values of k such that Prob(-k < Z < k) = 0.45

Result

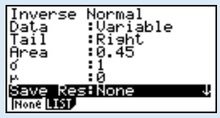
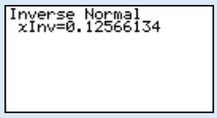
[F5] [F1] [F3] [▼] [F3] [▼] [0] [.] [4]
[5] [EXE] *then* [EXE]



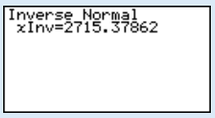


Normal Distribution Analysis [in STAT] cont.

Example 3

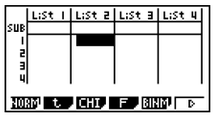
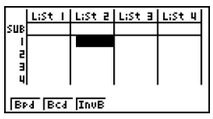
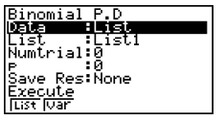
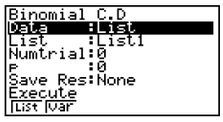
Find the values of k such that Prob(k < Z) = 0.45	*Result*
F5 F1 F3 ▼ F2 ▼ 0 . 4 5 EXE *then* EXE	 

Example 4

A machine produces ball bearings with the weights of each normally distributed with a mean of 2700 mg and a standard deviation of 12 mg. If 10% of the ball bearings are rejected as being overweight for the mechanism they are to fit into, find the maximum acceptable weight to the nearest mg. *Require the Prob(X > k) = 10% = 0.1, Area = 0.1, σ = 12 and μ = 2700.*	*Result*
F5 F1 F3 ▼ F2 ▼ 0 . 1 EXE 1 2 EXE 2 7 0 0 EXE *then* EXE	  *The maximum acceptable weight is 2715 mg (4 sig. fig.).*

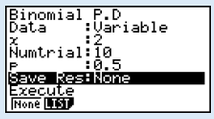
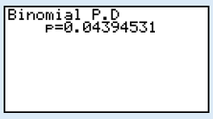
Binomial Distribution calculations [in STAT]

The Binomial Distribution(B.D.) has 2 parameters, the number of trials (n) and the probability of success (p).

KEY					
RESULT			 Individual B.D.	 Cumulative B.D.	 Inverse B.D.

Change the data as being **VAR**iable (you enter in the data) from LIST - press **[F2].**

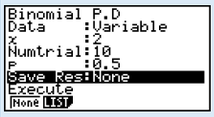
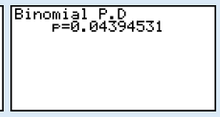
Example

Calculate the probability that from 10 trials there are two successful outcomes and the probability of a success is 0.5.	*Result*
F5 F5 F1 F1 ▼ 2 EXE 1 0 EXE 0 . 5 EXE *then* EXE	  *Probability = 0.0439 (4 d.p.)*

NORMAL, BINOMIAL AND POISSON DISTRIBUTIONS

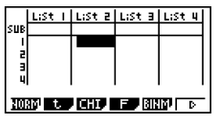
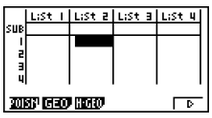
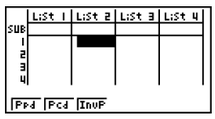
Binomial Distribution calculations [in STAT] cont.

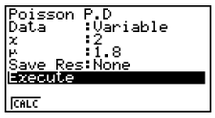
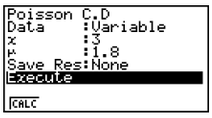
Example 2

Calculate the probability that from 10 trials there are at most two successful outcomes and the probability of a success is 0.5. Here x < 4 or x ≤ 3, i.e. x = 0, 1, 2 or 3.	*Result*
F5 F5 F2 F2 ▼ 3 EXE 1 0 EXE 0 . 5 EXE *then* EXE	  *Prob(x ≤ 3) = 0.0547 (4 d.p.).*

Poisson Distribution calculations [in STAT]

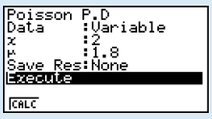
The Poisson Distribution (P.D.) has only one parameter, λ, the mean.

KEY			
RESULT			

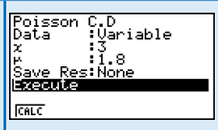
KEY			
RESULT			

Change the data as being **VAR**iable (you enter in the data) from **LIST** - press **[F2]** as illustrated with Normal and Binomial Distributions.

Example

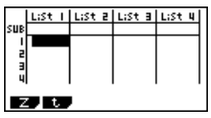
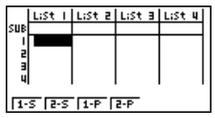
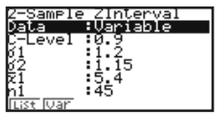
Calculate the probability that a carpet of size 1 square metre will have 2 flaws when the carpet generally has on average 1.8 flaws in it per square metre?	*Result*
F5 F6 F1 F1 F2 ▼ 2 EXE 1 . 8 EXE *then* EXE	  *Probability = 0.2678 (4dp)*

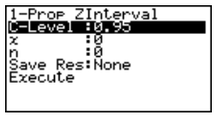
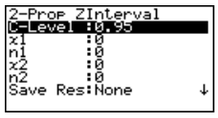
Example 2

Calculate the probability that from a carpet of size 1 square metre will have at most three flaws and the carpet generally has on average 1.8 flaws per square metre? Here x < 4 or x ≤ 3, i.e. x = 0, 1, 2 or 3.	*Result*
F5 F6 F1 F2 F2 ▼ 3 EXE 1 . 8 EXE *then* EXE	  *Probability = 0.8913 (4 d.p.)*

Confidence Intervals [in STAT]

There are four types of confidence interval calculations, one statistic (1-S), two statistic (2-S), one proportion (1-P), and 2 proportions (2-P).

KEY	F4	F1	F1	F2
RESULT				

KEY	F3	F3
RESULT		

Note:
You will have a choice of 4 different options of confidence intervals. 1-S, 2-S, 1-P, and 2-P. Use the function to select the one that fits with the statistics.

Confidence Intervals 1-S type

Example

Consider the following collected statistics. A sample was taken of worm lengths at different areas of a market garden. Test at the 95% confidence level, to see if there is a statistical difference between the worm lengths of this sample and the 'true' population mean.

Sample
n = 56
Mean = 10.4
Standard deviation = 2.3

Result

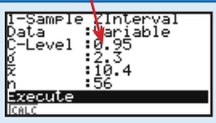
C-Level is at the 95% level

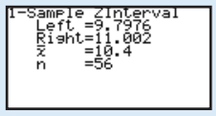
Set the calculator up so that inputted statistics is being used, not 'raw data'. As you can see raw data can be using in the LIST columns.

[F4] [F1] *Z-score* [F1] *[1-S]* [F2] *[VAR]*

[▼] [0] [.] [9] [5] [EXE] [2] [.] [3] [EXE] [1] [0]

[.] [4] [EXE] [5] [6] [EXE] *then* [EXE]





This gives the interval [9.7976, 11.002], hence the 'true' population mean for the worm lengths is in this interval, at the 95% confidence level.

[9.7976, 11.002]

Confidence Intervals 2-S type

Example

Consider the following collected statistics. Two samples were taken of worm lengths at different areas of a market garden. Test at the 90% confidence level, to see if there is a statistical difference between the worm lengths of two samples.

Sample 1	*Sample 2*
n = 45	*n = 80*
Mean = 5.4	*Mean = 5.3*
Standard deviation = 1.2	*Standard deviation = 1.15*

Result

cont. on next page

Confidence Intervals 2-S type cont.

Example cont.

C-Level is at the 90% level

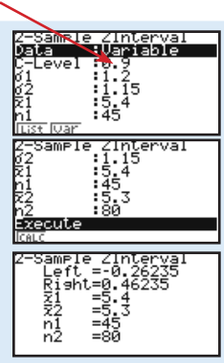
[F4] [F1] *Z-score* [F2] *[2-S]* [F2] *[VAR]*

[▼] [0] [.] [9] [EXE] [1] [.] [2] [EXE] [1] [.] [1]

[5] [EXE] [5] [.] [4] [EXE] [4] [5] [EXE] [5] [.] [3]

[EXE] [8] [0] [EXE] *then* [EXE]

*This gives the interval [-0.26235, 0.46235], hence there is **NO** statistical difference between the two samples as 0 is contained within the interval.*



[-0.26235, 0.46235]

Confidence Intervals 1-P type

Example

Consider the following collected statistics. A sample was taken of worm lengths at different areas of a market garden. Test at the 99% confidence level, to see what the 'true' population proportion is, if 55 out of 100 worms found were greater than 9.3cm in length.

Result

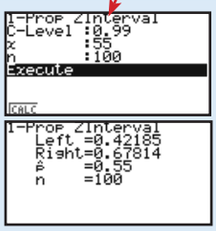
C-Level is at the 99% level

[F4] [F1] *Z-score* [F3] *[1-P]*

[▼] [0] [.] [9] [9] [EXE] [5] [5] [EXE] [1] [0] [0]

[EXE] *then* [EXE]

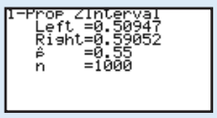
This gives the interval [0.42185, 0.67814], hence the true population proportion lies between 42% and 68% (2 sig.fig.) of worms with a length greater than 9.3 cm.



[0.42185, 0.67814]

***Remember:** The larger the sample size the more accurate the sampling results. i.e as n gets larger then the population statistic interval gets smaller.]*

If n = 1000, then these results would be calculated - a much smaller interval



Confidence Intervals 2-P type

Is used in a similar way to the three types illustrated above when comparing two population proportions. Enter into the statistics icon. Choose **[INTR] [F4]** then **[F1]** for **Z-score**. You now have a choice of 4 different options of confidence intervals. 1-S, 2-S, 1-P, and 2-P. This problem is a 2-P. So, press **[F4]**.

Notes:

A number of devices can be connected to the FX9750GII and other CASIO graphic calculators via the EA-200 data logger. [Previous data logger model EA-100 is also described as this data logger needs to have the data transferred to the calculator using small programs to send the information to the data logger and to receive the data collected back to the calculator for analysis. There are devices that can be used in supporting the use of the calculator in the classroom, bringing real life data into the classroom for analysis, as with the EA-2 motion detector. These two extensions can be easily attached to the G.C. and the information transferred to the **STAT** icon. Then use the statistical functions to model the data.

Connect various sensors to the EA-100 and EA-200 Data Analyser to collect various data relating to physics, chemistry, biology, and mathematics and analyse it with the graphic calculator.

1. **Temperature Probe**
   The temperature probe that comes with the data analyser uses a thermistor to measure the temperature of liquids. Changes in the temperature of the thermistor causes a corresponding change in its resistance, which is then converted to a temperature value.

2. **Voltage Probe**
   The voltage probe that comes with the data analyser can be used to read a voltage in the range of ±10 Volts. This probe is designed with Auto-ID resistance, so connecting it to the data analyser automatically switches to voltage sampling. The black probe should be connected to ground, while the red probe should be connected to signal voltage.

3. **Light Probe**
   The light probe that comes with the data analyser uses a photosensitive element called a Cds to measure brightness, which is then converted to a numeric value. The value produced does not correspond to any standard unit of measurement, but simply indicates a relative measure of brightness in the range of 100 to 999.

4. **Motion Detector**
   EA-2 is a sonar ranging device with a sensing range of 0.6 to about 8 meters. The EA-2 emits ultrasonic pulses and detects pulses returned as echoes from the target. It can be connected to the CASIO EA-100 data analyser to accumulate and analyse data.

5. **Other devices [Venier probes]**
   These can be purchased separately such as: Dissolved Oxygen Probe, Drop Counter; EKG Sensor, Electrode Amplifier, Flow Rate Sensor, Force Sensors, Gas Pressure Sensor, GPS Sensors, Gas Chromatograph, Hand Dynamometer to name a few. Please consult the User manual for aligning other probes to 'hank shake'

An overview of the Data Logger.

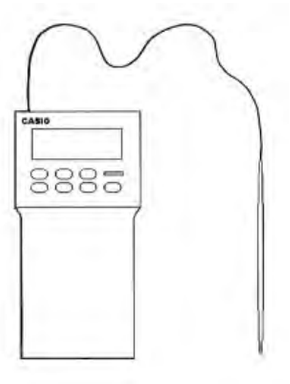
The EA-100 Data Logger features: 6 Channels: 3 analog inputs, 1 ultra-sonic motion detector input, 1 digital input, 1 digital output.

The unit automatically recognises the type of probe being connected to each channel. One temperature probe, one light probe and one voltage probe are included in the pack. Other types of probes are available. You can measure motion, temperature, light, force, sound, pH and more with the use of appropriate probes. The Data Logger allows for the display of data from the specified channel during the sampling to confirm when sampling is taking place and when the sampling has finished. You can collect data from up to five channels simultaneously (The 6th is reserved for time). The unit can collect data at rates of up to 10,000 data points per second for up to 250 data points (maximum entry for each column in **STAT** or **LIST** icon is 250 data values) per channel.

cont. on next page

CONNECTION TO OTHER DEVICES

A Quick Guide to Using the EA-100 Data logger - Manual Set Up



Step 1: Be sure to connect an Auto-ID probe to **CH1, CH2, CH3** or **SONIC** channel.

Step 2: Switch the Data Analyser to Communications mode by pressing the **[MODE]** key ("Done" appears on the screen).

Setting Time Interval, Number of Samples and Time Type

Time Interval Setting

Step 1: To access, press **[SHIFT] [MODE]**.

Step 2: Press **[Data Log]** to scroll through available settings.

Settings are:
Milliseconds: 10, 20, 50, 100, 200, 500
Seconds: 1, 2, 5, 10, 20, 30, 60

Press **[Trigger]** to set the Time Interval and to advance to the next setting

Time Interval Setting

Step 1: Press **[Data Log]** to scroll through available settings:

0, time recording off;

1, absolute time recording;

2, relative time recording

Step 2: Press **[Trigger]** to set the Time Setting.

Data Collection & Transfer

Data Collection

"Ready" appears on the display.

Step 1: Press **[Trigger]** for the Data Analyser to begin collecting data.

Step 2: "Done" appears when data collection is complete.

Data Transfer to a Graphics Calculator

Connect the calculator to the Data Analyser (Press plugs in firmly).

Step 1: Run the program **"MANUAL"** in the Program Mode of the calculator. Data will automatically be transferred to the calculator and a graph of this data displayed.

Data Analyser - Multimeter Mode

In this mode, the Data Analyser can perform a variety of different sampling operations using a selection of units. This mode can be used to sample voltage, resistance, current, period, frequency and distance. Sampling can be performed using **CH1, CH2, CH3, SONIC** or **DIG IN.**

To enter Multimeter Mode

Press **[MODE]** key. **MULTIMETER** indicator is displayed.

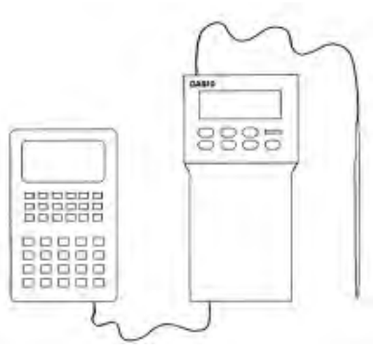
To select channel

Press **[CH-View]** key continuously until desired channel is displayed.

To change sampling unit

Press **[Data Log]** key continuously until desired unit is displayed. **Note:** The Data Analyser's Auto Power Off feature is not active in this mode.

Data Analyser - Program Mode Equipment Set Up



Step 1: Connect the calculator to the Data Analyser using the cable. Press ends in firmly. A definite "Click" sound is heard. Be sure to connect an Auto-ID probe to CH1, CH2, CH3 or SONIC channel

Step 2: Switch the Data Analyser to Communications mode by pressing the **[MODE]** key ("Done" appears on the screen)

Step 3: Turn the calculator on. Access the Program Mode of the calculator. Select and execute the program **you have written** to be used with an activity.

Step 4: Follow the prompts on the calculator display whilst also taking note of the procedure for the activity.

Data Collection, Transfer and Analysis

"Ready" appears on the display.

Step 1: Press **[Trigger]** for the Data Analyser to begin collecting data.

Step 2: Depending on the activity, data can be collected "Real Time" or data can be collected then displayed on the calculator graphically on completion of the data collection.

Step 3: "Done" appears on the Data Analyser display when data collection is complete.

Step 4: The program will normally contain instructions which automatically transfers the data to the calculator.

Step 5: A graph of the data will also be displayed and further mathematical analysis can be performed.

Using the EA-100 Data Logger with a probe

This activity looks at:

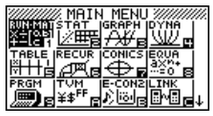
- use the data analyser to collect data on time and temperature.
- transfers data from the data analyser to the calculator.
- use the calculator to graph the relationship between time and temperature.
- use a mathematical model to model the collected data.
- Application of Newton's Law of Cooling.

Data Transfer to a Graphics Calculator.

Step 1: Connect the calculator to the Data Analyser (Make sure that the plugs are in firmly.

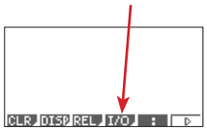
Step 2: In **RUN** mode and using **PRGM** [**SHIFT**] **[VARS]** .

Alternatively a 'short' program in the **PRGM** icon from the **MAIN MENU** will do this data transfer from the Data Logger to the calculator very quickly.



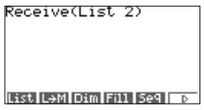
then **[F6]**

and **[F4]**



[F4] for **Receive.**

For List 1 etc **[OPTN] [F1]** & **[F1]** again.



List 1 is **TIME** and List 2 is the **TEMPERATURE** reading.

The example shown in this worksheet is to show how heat is lost from a hot cup of water when it is placed in a room, free standing, to cool.

Two experiments are conducted, one with a simple cup of water and the second with a cup of water with a metal spoon placed in the water to act as a "radiator" to compare and to see if there is any difference in the cooling rates.

CONNECTION TO OTHER DEVICES

Procedure

Step 1: Heat approximately 250 ml of water. Bring it to the boil (approx 100° C).

Step 2: Place the thermometer probe into the cup of water after it has been heated.

Step 3: Set the rate of sampling of the EA-100 at 10 seconds and the number of samples to be taken at 200. Start the data gathering with the EA-100 and relax for the next 33 minutes and 10 seconds.

Step 4: Transfer the data from the EA-100 to the calculator.

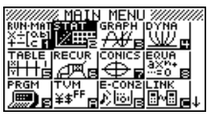
Step 5: Analyse the data collected as a time series. Fit an appropriate mathematical model to the data collected.

Step 6: Repeat the experiment with the spoon in the cup of water.

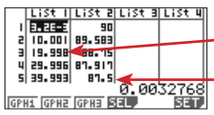
Analysis of the Results

The trend of the two curves displays the rate of cooling for the water. You may expect some results to differ as this is dependent on different surface areas, different composition containers, addition of insulating materials, etc.

The analysis is done in the **STAT** icon, setting the statistical graph to be either a time series or scattergraph.



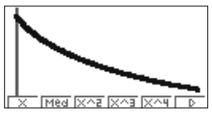
Result #1: Without the spoon:

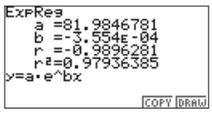


Time (sec)

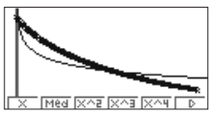
Temp (ºC)

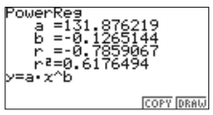
An exponential model:





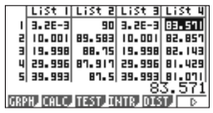
A power model:



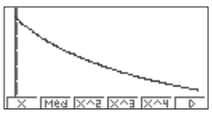


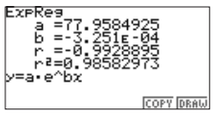
From the value of r^2 and comparing the two mathematical models, the exponential model is the 'best fitting'.

Result #2: With the spoon: Transfer the data from the Data Logger into List 3 and List 4 of the calculator.

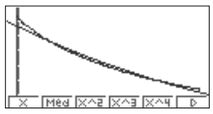


An exponential model:





The theoretical model displayed.
$y = 77.958e^{-0.000325}$

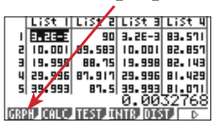


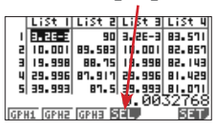
Making comparisons between the cooling (i) without and (ii) with the spoon (radiator). The spoon 'absorbs' the heat – heats up – (logarithmically). So the initial temperature is lower, but the cup of water cools at similar rates.

Without spoon: $y = 81.985^{-0.000355}$ With spoon: $y = 77.958e^{-0.000325}$

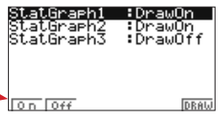
Graphically, viewing both time series or scattergraphs simultaneously:

select **[F1]** then **[F4]**



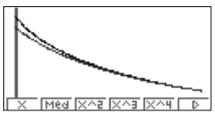


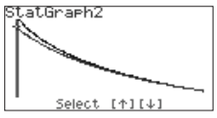
Then turn **StatGraph1** and **StatGraph2** on by pressing **[F1]**.

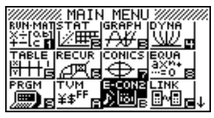


Note: *Newton's Law of Cooling states: That the time a substance takes to cool off depends on the* temperature difference between the substance and the surroundings.

[F6] will draw the two graphs.



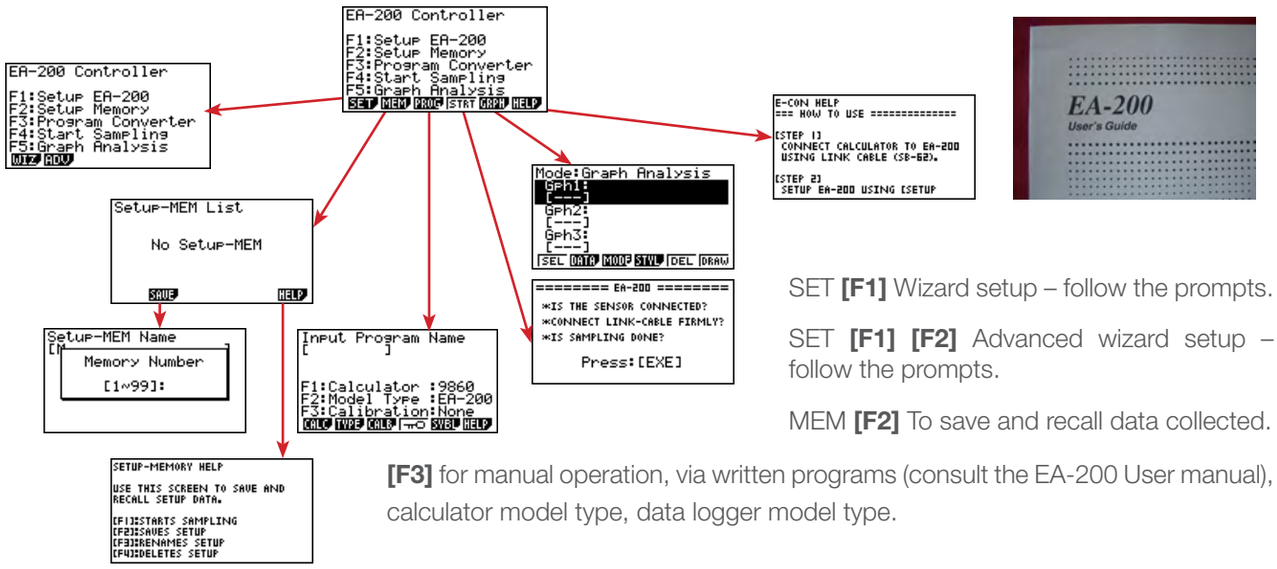




The EA-200 Data Logger features:

Using the **E-CON2** icon from the **MAIN MENU.**

The introduction of this new icon to the **MAIN MENU** on the FX9750GII has enabled the setting up of the devices that can be attached to the calculator easy by following the prompts on the screen using the **WIZ**ard via **SET [F1]**.

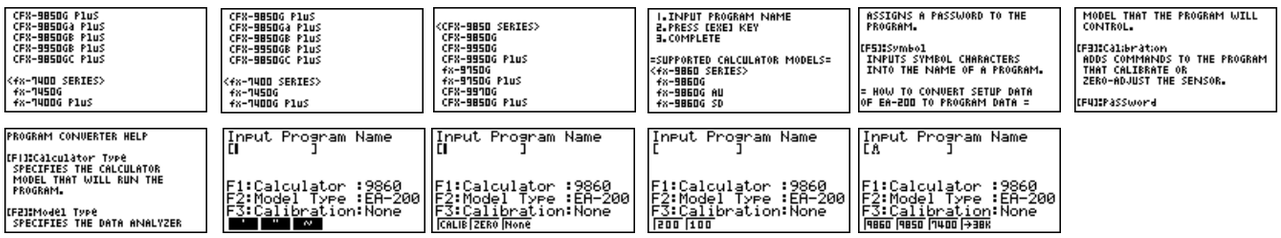


SET **[F1]** Wizard setup – follow the prompts.

SET **[F1] [F2]** Advanced wizard setup – follow the prompts.

MEM **[F2]** To save and recall data collected.

[F3] for manual operation, via written programs (consult the EA-200 User manual), calculator model type, data logger model type.

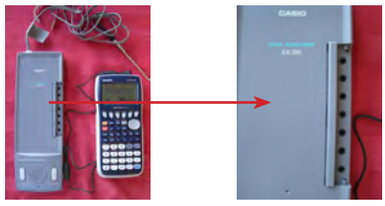


[F4] Activate the data collecting from the data logger and probe in use.

[F5] Graphing of data results setup – follow the prompts.

[F6] Need some help – follow the prompts.

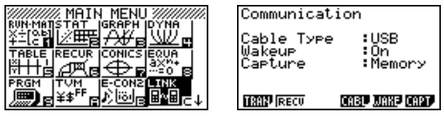
Using the **HELP** Function key – use the down arrow to view more information to assist you in using the **E-CON2** icon.

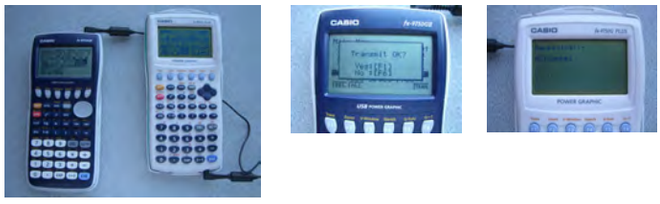


The EA-200 has a master connection for the graphic calculator 'instructing the analyser' and can be connected to a maximum of 6 graphic calculators to also receive the data (see picture to right).

Analysis of the Results

Calculator to calculator connection is via the SB-62 cabling. Data transfer of files, screen captures, lists and other items can be transferred. Note that the calculators can be of different models as shown in the pictures below. The receiving calculator needs to be set up first and the transfer calculator. Make sure that the cabling is securely placed in to the docking port. Follow the prompts that appear on the screen with the Function keys.





CONNECTION TO OTHER DEVICES

Calculator to computer data transfer

Calculator to calculator connection is via the 5-pin/USB cabling. Follow the Function keys for setting up this feature via **LINK** from the **MAIN MENU.**

Calculator to data projector data transfer

Calculator to calculator connection is via the 5-pin/USB cabling. Follow the Function keys for setting up this feature via **LINK** from the **MAIN MENU.**

Notes:

Key	Primary Function	Combined with SHIFT	Combined with ALPHA
Trace F1	Turns trace function on/off. Selects first function menu item		
Zoom F2	Turns zoom function on. Selects second function menu item		
V-Window F3	Displays View Window parameter input screen. Selects third function menu item		
Sketch F4	Displays sketch menu. Selects fourth function menu item		
G-Solv F5	Displays graph solve menu. Selects fifth function menu item		
G ↔ T F6	Switches display between graph and text screens. Selects sixth function menu item		
SHIFT	Activates shift functions of other keys and function menus		
OPTN	Displays option menu		
PRGM VARS	Displays the variable data menu.	Displays program command menu	
SET UP MENU	Returns to the Main Menu.	Shows the set up display	
A-LOCK ALPHA	Allows entry of alphanumeric characters shown in red	Locks/Unlocks entry of alphanumeric characters	
√ R x^2	Press after entering value to calculate square	Press before entering value to calculate square root	Enters character r
^{x}√ θ ^	Press between two values to make second value exponent of first	Press between entering values for X and Y to show x^{th} root of y	Enters character θ
QUIT EXIT	Back steps to the previous menu	Returns directly to initial screen of the mode	
▲	Moves cursor upward. Scrolls through the screen items	Switches to previous function in trace mode	
▼	Moves cursor downward. Scrolls screen.	Switches to next function in trace mode	
◀	Moves cursor to left. Scrolls screen. Press after EXE to display calculation from end	Picture /screen capture	
▶	Moves cursor to right. Scrolls screen. Press after EXE to display calculation from beginning	'cut' and 'paste'	
A X, θ, T	Allows input of variable X, θ and T		Enters letter A

KEY INDEX

Key	Primary Function	Combined with SHIFT	Combined with ALPHA
10^x B log	Press before entering value to calculate common logarithm	Press before entering exponent value of 10	Enters letter B
e^x C ln	Press before entering value to calculate natural logarithm	Press before entering exponent value of e	Enters letter C
$\sin^{-1}$ D sin	Press before entering value to calculate sine	Press before entering value to calculate inverse sine	Enters letter D
$\cos^{-1}$ E cos	Press before entering value to calculate cosine	Press before entering value to calculate inverse cosine	Enters letter E
$\tan^{-1}$ F tan	Press before entering value to calculate tangent	Press before entering value to calculate inverse tangent	Enters letter F
d/c G $a\,^b/_c$	Press between entering fraction values. Converts fraction to decimal	Displays improper fractions	Enters letter G
H F↔D	Converts a fraction to a decimal value or a decimal value to a fraction. Sends a shot of the current screen to a connected device		Enters letter H
$\sqrt[3]{}$ I (	Enters open parenthesis in formula	Press before entering value to calculate cube root	Enters letter I
x^{-1} J)	Enters close parenthesis in formula	Press after entering value to calculate reciprocal	Enters letter J
K ,	Enters a comma		Enters letter K
L →	Assigns value to a value memory name		Enters letter L
CAPTURE M 7	Enters number seven	... 'paste'	Enters letter M
CLIP N 8	Enters number eight	Allows insertion of characters at cursor location	Enters letter N
PASTE O 9	Enters number nine	Turns power off	Enters letter O
INS DEL	Deletes character at current cursor location	View a lists of commands which can be copied to the screen	
OFF AC/ON	Turns power on. Clears the display		
CATALOG P 4	Enters number four		Enters letter P
Q 5	Enters number five		Enters letter Q
R 6	Enters number six		Enters letter R
{ S x	Multiplication function	Enters open curly set bracket	Enters letter S

Key	Primary Function	Combined with SHIFT	Combined with ALPHA
} T ÷	Division function	Enters close curly set bracket	Enters letter T
List U 1	Enters number one	'Hot key' for list	Enters letter U
Mat V 2	Enters number two	'Hot key' for Matrix	Enters letter V
W 3	Enters number three		Enters letter W
[X +	Addition function. Specifies positive value	Enters open bracket	Enters letter X
] Y -	Subtraction function. Specifies negative value	Enters close bracket	Enters letter Y
i Z 0	Enters number zero	Enters the imaginary number i	Enters letter Z
= SPACE .	Enters decimal point	Enters character equals	Enters a blank space
π " EXP	Allows entry of exponent	Inputs the value of pi. Enters the pi symbol	Enters speech marks for displaying statements
Ans (-)	Enter before value to specify as negative number	Recalls the most recent calculation result displayed	
↵ EXE	Displays result of calculation	Inputs a new working line on the screen	

A

B

C

D

D cont.

E

F

G

G cont.

O cont. PAGE

S cont.

T

U

V

V cont.

X

Z