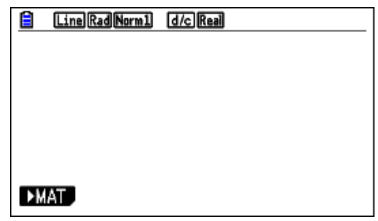
Matrices

This resource sheet is designed for use with the Casio fx-CG20. However it can be used with the Casio fx-9860GII or the Casio fx-9750GII although there may be some differences in the key sequences needed and in the screen displays.

Aim

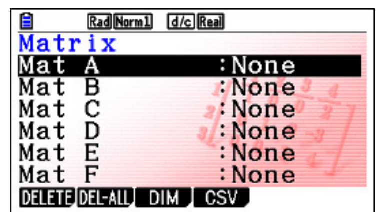
This activity will show you how the calculator can be used to deal with matrices. You will be exploring how to add, subtract and multiply matrices. The investigations are designed to help students find the determinant and inverse of a matrix as well as investigating how matrices can be used to describe transformations.

Put the calculator in RUN-MAT mode by pressing [MENU] [1]

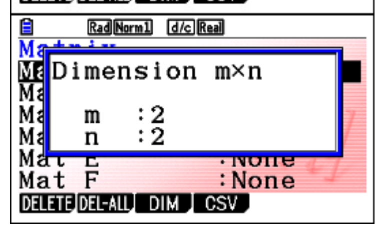


Select 'Set-up' by pressing [SHIFT] [MENU] and select 'Linear' for Input/output by selecting [F2]

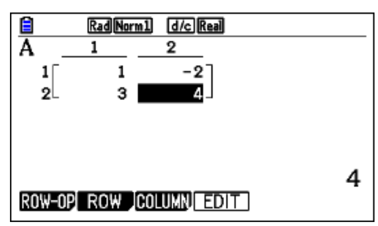
Go to the Matrix table by selecting Mat [F1] from the menu bar.



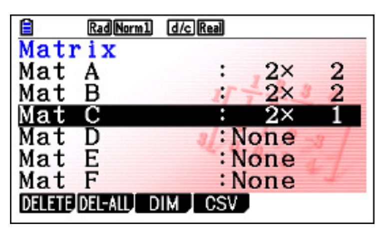
To enter a matrix press [EXE] and you will be asked to select the dimensions for your matrix. 'm' is the number of rows and 'n' the number of columns.



If Martrix A is $\begin{pmatrix} 1 & -2 \\ 3 & 4 \end{pmatrix}$, first enter m = 2 and n = 2 into the calculator pressing [EXE] after each selection.



Enter the four values again pressing [EXE] after each selection. Press [EXIT] to return to the main matrix screen.

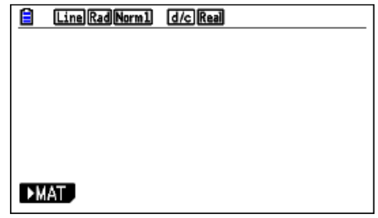


Enter $\begin{pmatrix} 2 & -2 \\ -1 & 4 \end{pmatrix}$ as matrix B

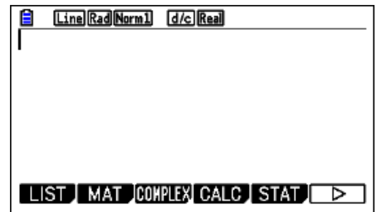
Enter $\begin{pmatrix} -1 \\ 2 \end{pmatrix}$ as matrix C

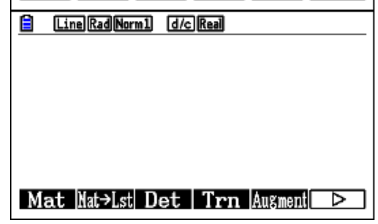
Matrices

Press EXIT EXIT to return to the main RUN screen.



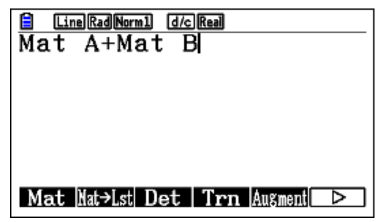
Press OPTN F2 to bring up the Matrix menu bar



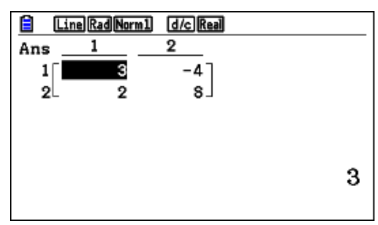


To add matrix A to matrix B we need to key in Mat A + Mat B.

Use F1 to print “Mat” on the screen. You will need to use the ALPHA key to access the letters, so ALPHA X,θ,T gives you ‘A’



Press EXE for the result.



Matrices

You should now feel fairly confident using basic matrices on the calculator. Here are some investigations that will encourage your students to explore some of the features of matrices using the graphics calculator.

Investigations

Investigation 1

Find:

a) Matrix A – Matrix B
b) 2 x Matrix A
c) Matrix B x Matrix C
d) Matrix C x Matrix B

What do the results of c) and d) tell us about multiplication of matrices and why does this happen?

Investigation 2

Clear all the previous matrices in the calculator.
Enter the following matrices

Matrix A	$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$	Matrix D	$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$
Matrix B	$\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$	Matrix E	$\begin{pmatrix} 3 & 0 \\ 0 & 3 \end{pmatrix}$
Matrix C	$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$	Matrix F	$\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$

Matrix G represents a triangle set in the x-y plane with the coordinates of the vertices being (1,0), (3,0) and (3,2). Enter matrix G as $\begin{pmatrix} 1 & 3 & 3 \\ 0 & 0 & 2 \end{pmatrix}$

Find Matrix A x Matrix G, Matrix B x Matrix G and so on for matrices A to F.
Sketch the results on graph paper and suggest a geometrical transformation that is represented by each of the six matrices A to F.

Check your suggestion by multiplying each by $\begin{pmatrix} 3 & 5 & 5 \\ 2 & 3 & 4 \end{pmatrix}$

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Investigation 3

You can find the inverse of a matrix by using the reciprocal (x^{-1}) operation.

To find the inverse of $\begin{pmatrix} 1 & -2 \\ 3 & 4 \end{pmatrix}$, enter the matrix into your calculator. I am entering it as matrix H so that I can keep the matrices from investigation 2.

Then in the RUN screen simply enter Mat H x^{-1}. You will find x^{-1} by pressing SHIFT) .

Using the matrices from investigation 2, Find the inverses of matrices A to F

What geometric transformations do they represent?

How do these transformations compare with the transformations represented by the original matrices?

Try finding the inverse of matrix J = $\begin{pmatrix} 1 & -2 \\ 3 & -6 \end{pmatrix}$. What happens?

Find the determinant of the matrix J by entering

MENU 1 to get to the RUN screen

OPTN F2 for Matrices

F3 for Det

F1 ALPHA) for Mat J

EXE

Does this always happen with matrices with this determinant? Make up some more matrices of your own that have the same feature and check. Why should this be the case?