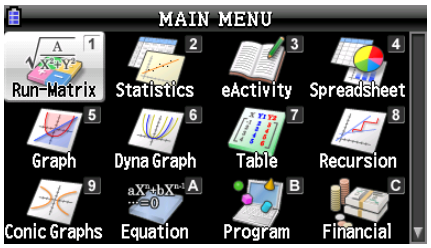
Basic Matrix Manipulation with a Casio Graphing Calculator

Often, a matrix may be too large or too complex to manipulate by hand. For these types of matrices, we can employ the help of graphing calculators to solve them.

I will be using the Casio Prizm for these examples, so my screens may look a little different than yours, but the steps should be similar. Throughout the directions, calculator buttons with arrows indicate the operation order. To learn more about your Casio, consult the manufacturer's product manual.

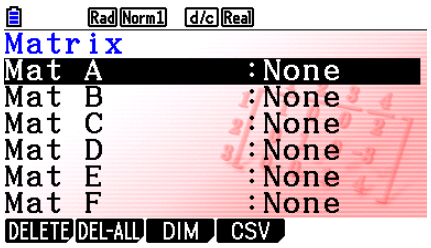
Inputting/Editing Matrices:

Before we can work with matrices, we must first input them into the calculator. If not there already, choose the "Run-Matrix" option from the Main Menu screen.

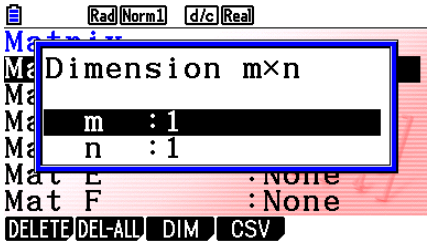


To enter the Matrix Editor, press the [F3] key. The Casio contains predefined matrix variables labeled "Mat A" through "Mat Z" and "Mat Ans".

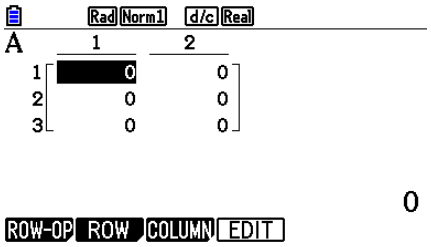
Inputting matrices into the Casio is easy. From this screen, use the ▲ and ▼ arrow keys to select a matrix name. Let's use "Mat A" since it is already selected, so press [EXE].



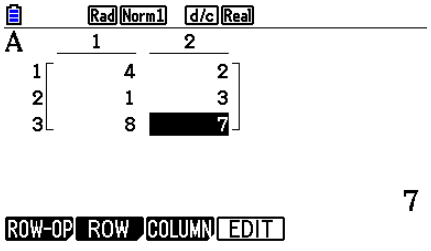
Since we are creating a new matrix, the calculator displays a default 1x1 dimension. Let's say we want a 3x2 matrix instead. Type: [3] → [EXE] → [2] → [EXE] → [EXE].



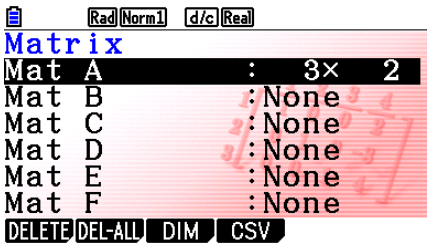
You should now have this screen. As you can see, we have a 3x2 matrix filled with zeros. To input your own matrix, type in each element of the matrix row-by-row. That is, to enter the matrix $\begin{bmatrix} 4 & 2 \\ 1 & 3 \\ 8 & 7 \end{bmatrix}$, type [4] → [EXE] → [2] → [EXE] → [1] → [EXE] → [3] → [EXE] → [8] → [EXE] → [7] → [EXE].



And this is what you should have. Before we can use this matrix, we need to first exit the Matrix Editor. To do this, simply press the [EXIT] key twice. Pressing [EXIT] once will take us back to matrix list.

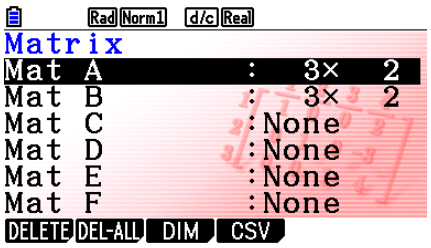


At the matrix list, notice that "Mat A" now has the dimension of our matrix beside it. This is how we know that a matrix has already been entered into the calculator. To edit this matrix, select the matrix you want to edit and press [EXE]. The stored matrix will be displayed for editing. If you need to change the dimensions of a matrix, select it and press [F3] for "DIM"; this will display the same "Dimension" screen as before. Note that after changing the dimensions, the matrix will default back to all zeros.



Adding and Subtracting Matrices:

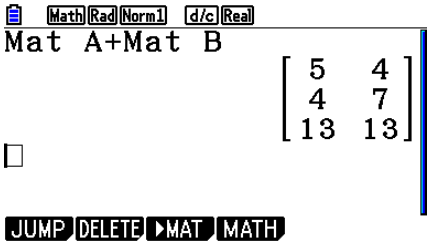
Enter two matrices into the calculator, one in "Mat A" and one in "Mat B". For this example, $A = \begin{bmatrix} 4 & 2 \\ 1 & 3 \\ 8 & 7 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix}$. In order to use a matrix in a computation, type [SHIFT] → [2] (for "Mat") → [ALPHA] → letter name of the matrix.



To add these two matrices together, do the following:

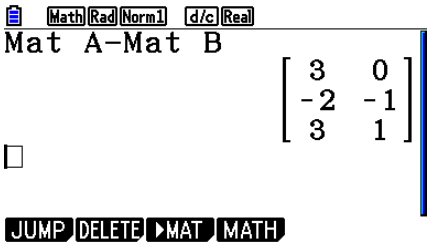
[SHIFT] → [2] → [ALPHA] → [X,θ,T] (for "A") → [+] → [SHIFT] → [2] → [ALPHA] → [log] (for "B") → [EXE]

If done correctly, you should see the screen on the right.



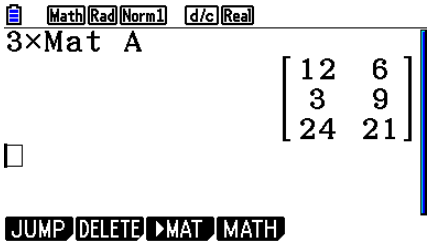
Subtracting matrices is similar, except type a subtraction sign instead of an addition sign.

(Remember, matrices must be the same dimension in order to add or subtract them. The calculator will return an error if the dimensions are not the same.)

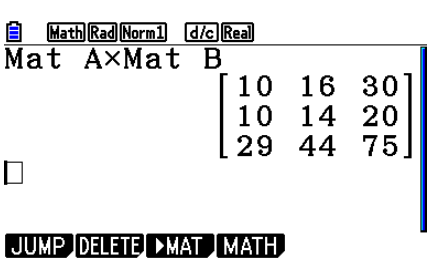


Multiplying Matrices:

Matrix multiplication is easy on the Casio. For scalar multiplication, multiply the number times the matrix just like multiplying two numbers together. For example, to multiply 3 times the matrix A, type [3] → [×] → [SHIFT] → [2] → [ALPHA] → [X,θ,T] (for "A") → [EXE].

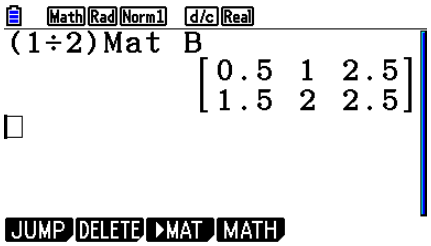


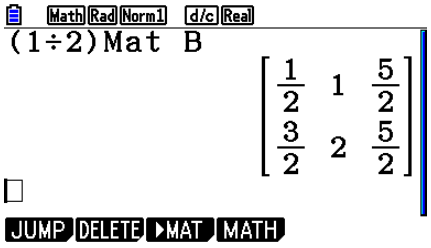
Multiplying two matrices together is just as easy. However, remember to have the correct matrix dimensions, otherwise the calculator will give a "Dimension" error. For this example, $A = \begin{bmatrix} 4 & 2 \\ 1 & 3 \\ 8 & 7 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 2 & 5 \\ 3 & 4 & 5 \end{bmatrix}$. Try duplicating my screen by multiplying A and B together.



Notice that sometimes with scalar multiplication, if the scalar is a fraction, we may get decimals in our answer. But what if we wanted fractions instead? After performing the calculation, simply press the F⇔D button to convert the decimals to fractions.

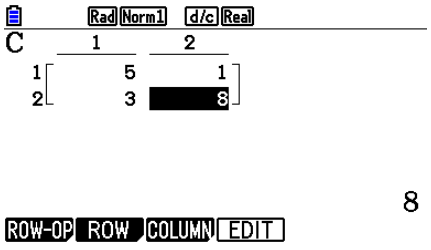
Unlike some other graphing calculators, the Casio Prizm understands "$B/2$" to be the same as "$(1/2)B$".





Calculating the Inverse:

To calculate a matrix inverse, first input $\begin{bmatrix} 5 & 1 \\ 3 & 8 \end{bmatrix}$ as matrix C into the Casio. (Of course the matrix must be square, otherwise the calculator will return a "Dimension" error). Don't forget to EXIT out of the Matrix Editor.

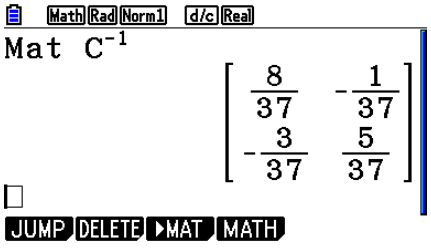


To calculate the inverse of C, you can do either of the following:

SHIFT → 2 → ALPHA → ln (for "C") → ^ → (−) → 1 → EXE

OR

SHIFT → 2 → ALPHA → ln (for "C") → SHIFT →) → EXE

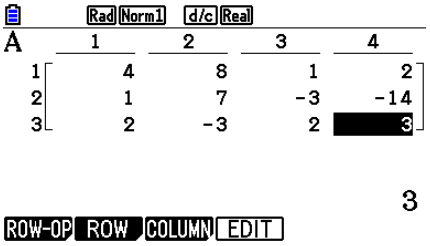


Gaussian and Gauss-Jordan Elimination:

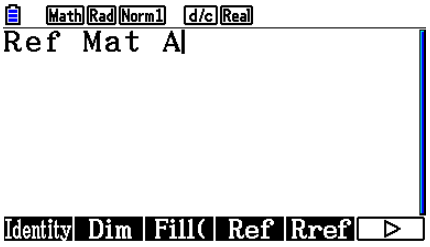
Let's use these two methods to solve the following system of equations:

$$\left.\begin{array}{l} 4x + 8y + z = 2 \\ x + 7y - 3z = -14 \\ 2x - 3y + 2z = 3 \end{array}\right\} \rightarrow \begin{bmatrix} 4 & 8 & 1 & 2 \\ 1 & 7 & -3 & -14 \\ 2 & -3 & 2 & 3 \end{bmatrix}$$

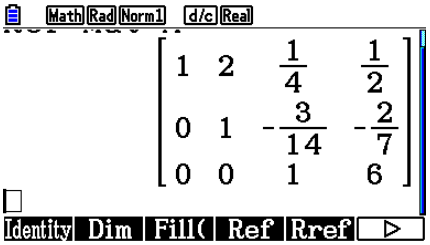
Enter the augmented matrix into matrix A.



Exit out to the "Run-Matrix" screen. Let's first try solving the system using the Gaussian Elimination method. Press [OPTN] then [F2] to display the menu of commands for matrices. Press [F6] to scroll the menu, then press [F4] for "Ref" ("Row-Echelon Form"). Type in the matrix name and press [EXE] to run the command.

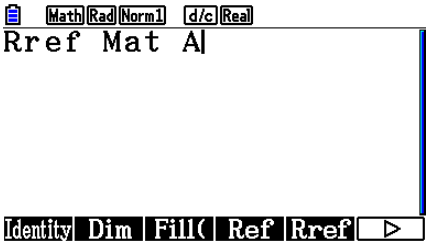


Note that if you swap rows, the matrix given by the "Ref" command may not match the matrix obtained by performing the Gaussian elimination by hand. That is fine; the final solution will still be the same.

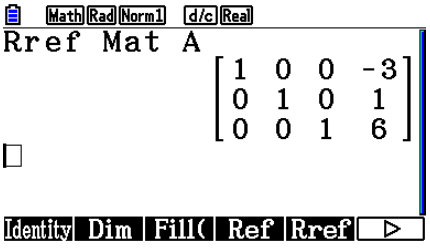


Now let's try the Gauss-Jordan elimination method. If you have calculated this method by hand, then you know that the answer will be obtained at the end. The same applies to the Casio.

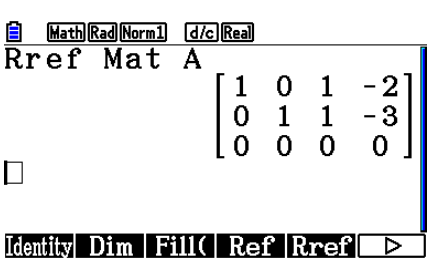
Return to the menu of matrix commands, but this time press [F5] for "Rref" ("Reduced Row-Echelon Form"). Type in the matrix name and press [EXE] to run the command.

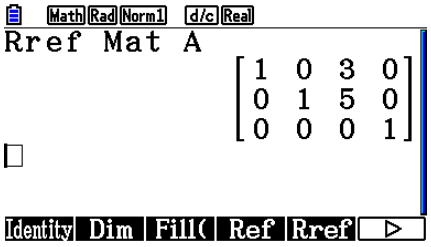


There we go! The solution to our system of equations is (-3, 1, 6).



Now what if we have a dependent or inconsistent system? The "Rref" command will still work on the augmented matrices of these systems, but with different results than above. For a dependent system, a matrix with the last row all zeros would be returned (first picture on the right). For an inconsistent system, a matrix would be returned where the last row contains all zeros except for a final element of "1" (second picture on the right).

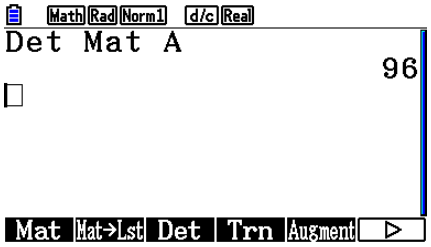




Determinants:

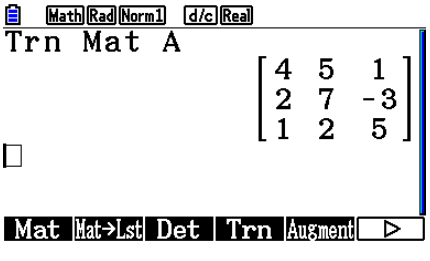
Enter this matrix as "Mat A" in the calculator: $\begin{bmatrix} 4 & 2 & 1 \\ 5 & 7 & 2 \\ 1 & -3 & 5 \end{bmatrix}$

To calculate the determinant of A, press [OPTN] then [F2] to display the menu of commands for matrices, and then press [F3] for "Det". Type in the matrix name and press [EXE] to run the command. That's it! The determinant of this matrix is 96.



Transpose:

Let's calculate the transpose of $\begin{bmatrix} 4 & 2 & 1 \\ 5 & 7 & 2 \\ 1 & -3 & 5 \end{bmatrix}$. If it is not there already, input this matrix as "Mat A" in the calculator. In the menu of commands for matrices, press [F4] for "Trn". Type in the matrix name and press [EXE] to run the command.



Deleting Matrices from the Calculator:

Deleting matrices from the Casio is safe and easy. From the "Run-Matrix" screen, press [F3] to view the matrix list. Use the ▲ and ▼ arrow keys to select the matrix that you want to delete. After doing so, press [F1] to delete that matrix. The calculator will ask if you are sure; press [F1] to confirm.

If you instead want to delete all of the stored matrices, then press [F2] in the matrix list. Finally, press [F1] to confirm.