CHAPTER 6 Calculator Notes for the TI-89, TI-92 Plus, and Voyage 200

Note 6A • Entering and Editing Matrices

You can enter a matrix into the Data/Matrix Editor or into the Home screen.

Entering a Matrix into the Data/Matrix Editor

a. Press APPS, open the Data/Matrix Editor, and select **3:New...**.

b. For **Type**, select **Matrix**.

c. For **Folder**, select the folder in which you want to save the matrix.

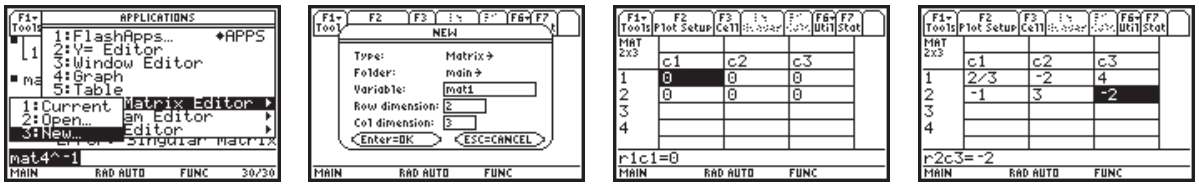
d. For **Variable**, type the matrix name. Some names are reserved; if you try to use a reserved name you will get an **ERROR** message.

e. Enter the row and column dimensions of the matrix.

f. Press ENTER ENTER to display the matrix on the Data/Matrix Editor screen. Initially all entries are zeros.

g. Enter a value into each cell. Press ENTER to register each entry and move the cursor to the next position. You can use fractions and operations when you enter values.

h. When you finish entering values, press HOME to return to the Home screen.

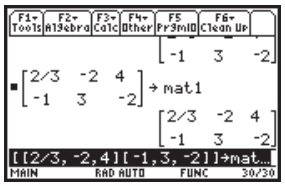


Entering a Matrix into the Home Screen

To enter a matrix into the Home screen, use one set of brackets, [and], around the entire matrix and one set of brackets around each row. Use commas to separate the entries in a row. Then press STO→, type a name for the matrix, and press ENTER.

For example, to define the matrix $[\text{mat1}] = \begin{bmatrix} \frac{2}{3} & -2 & 4 \\ -1 & 3 & -2 \end{bmatrix}$ enter

[[2/3,−2,4] [−1,3,−2]] STO→ **mat1** ENTER.



Some names are reserved; if you try to use a reserved name you will get an **ERROR** message. Notice that the folder in which the matrix is now stored is indicated in the left corner of the status line. In this example, **mat1** is stored in the **MAIN** folder.

(continued)

Editing a Matrix

To edit a matrix, use the Data/Matrix Editor.

a. Press APPS, open the Data/Matrix Editor, and select **2:Open...**.

b. For **Type**, select **Matrix**.

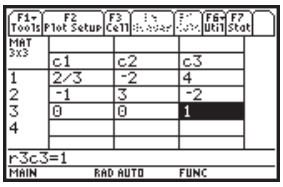
c. For **Folder**, select the folder in which the matrix is stored.

d. For **Variable**, select the matrix you want to open and edit.

e. Press ENTER to display the matrix on the Data/Matrix Editor screen.

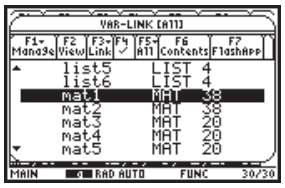
f. Arrow to the cell you want to edit. Enter the new value and press ENTER. You can also change the dimensions of a matrix while you are editing by entering a value into a new row or column. Notice that when you create a new row or column the other values in the row or column automatically become zeros. You can then change the zeros to other values.

g. When you finish editing, press HOME to return to the Home screen.

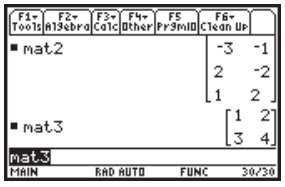


Viewing a Matrix on the Home Screen

You can see a complete list of all the matrices stored in your calculator by pressing 2nd [VAR-LINK] and scrolling through the contents of each folder. To see a list of matrices only, press 2nd [VAR-LINK] F2, for **Var Type** select **Matrix**, and press ENTER.

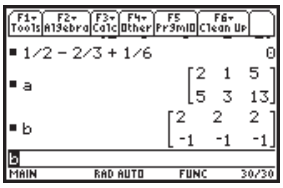


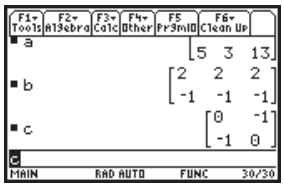
To view a matrix on the Home screen, type its name into the entry line and press ENTER. You can also select the matrix's name from the Var-Link screen.



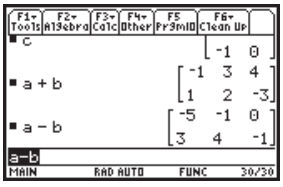
Note 6B • Matrix Operations

You can perform operations with matrices just as with numbers. The following examples use matrices [*A*], [*B*], and [*C*].





You can add or subtract matrices if they have the same dimensions.



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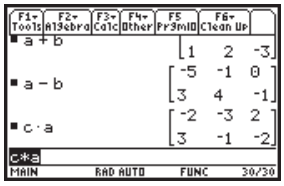
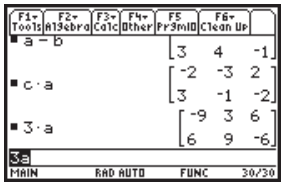
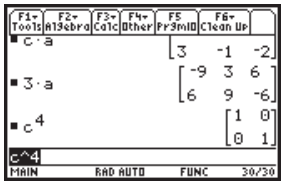
You can multiply two matrices if the number of columns in the first matrix matches the number of rows in the second matrix. Remember to use the multiplication symbol.



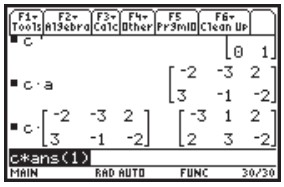
You can multiply any matrix by a constant.

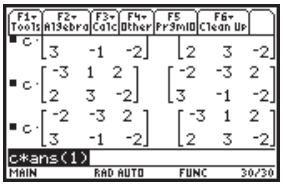


You can raise a square matrix to a power.



The result of a matrix operation can be stored into a matrix or used in the next calculation. You can work recursively with matrices the same way you do with numbers or lists.





Errors

You will get an **ERROR:Dimension** message if the dimensions of the matrices do not satisfy the operation's criteria.

If you use a variable that is not defined as a matrix, you may get an error message or an unusual result.

Note 6C • Plotting a Polygon

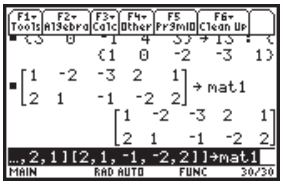
You cannot plot a polygon directly from a matrix, but you can convert a matrix into a list. Then, by dividing the list into two lists, you can plot a polygon.

For example, the matrix $\begin{bmatrix} 1 & -2 & -3 & 2 & 1 \\ 2 & 1 & -1 & -2 & 2 \end{bmatrix}$ represents the quadrilateral with vertices $(1, 2)$, $(-2, 1)$, $(-3, -1)$, and $(2, -2)$. (To graph

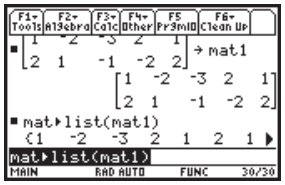
(continued)

a closed figure, the first point must be repeated as the last point.) You can plot the polygon by following these steps:

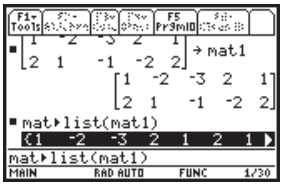
a. Enter the matrix and store it as **mat1**.

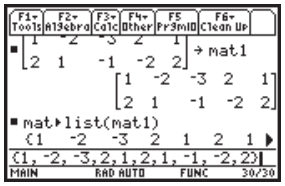


b. On the Home screen, enter 2nd [MATH] **3:List F:mat ▸ list(**, then type **mat1**) and press ENTER.

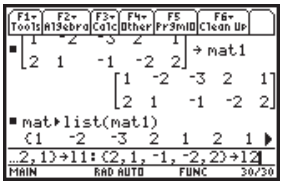


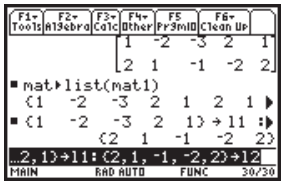
c. Arrow up to highlight the list in the bottom line of the history section of the Home screen. Press ENTER.





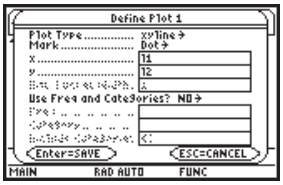
d. Divide the list, which is now in the entry line, into two lists of equal length by inserting braces, } and {. Store the first list as list **l1** and store the second list as list **l2**. Separate the two storing commands with a colon, 2nd [:].

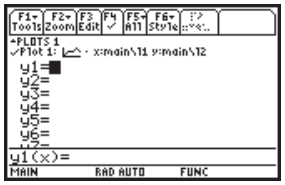




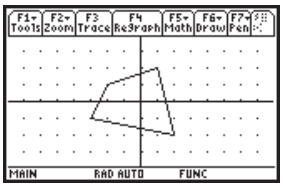
e. Go to the Y= Editor screen, scroll up to **Plot 1**, and press F3 (**Edit**).

f. For **Plot Type** select **xyline**, for **x** enter **l1**, and for **y** enter **l2**.





g. Set an appropriate window and display the graph.



[−7.9, 7.9, 1, −3.8, 3.8, 1]

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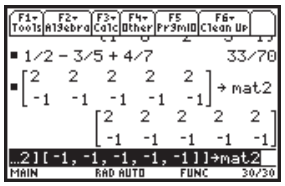
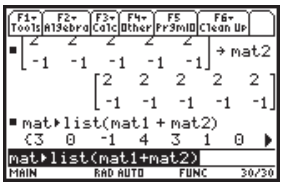
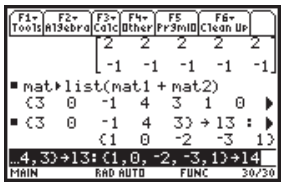
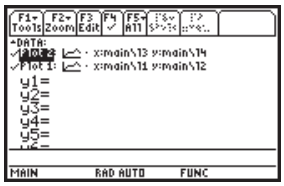
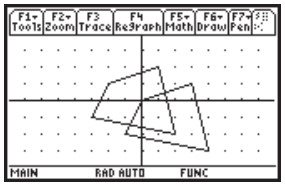
You can also use matrices to transform polygons.

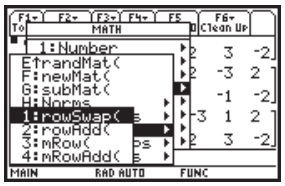
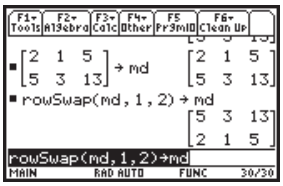






[−7.9, 7.9, 1, −3.8, 3.8, 1]

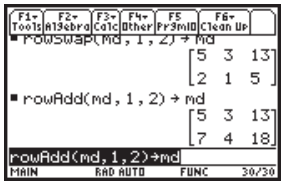
Note 6D • Matrix Row Operations

The calculator can perform four operations on the rows of a matrix.

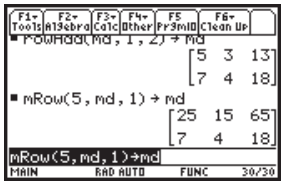
To exchange two rows in one matrix, use 2nd [MATH] **4:Matrix J:Row ops 1:rowSwap(**. For example, you exchange rows 1 and 2 of matrix **md** with the command **rowSwap(md,1,2)**.

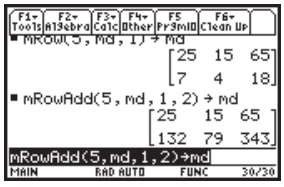
To add the entries of one row to those of another row, use 2nd [MATH] **4:Matrix J:Row ops 2:rowAdd(**. For example, you add the entries of row 1 to those of row 2 and store them into row 2 with the command **rowAdd(md,1,2)**.



To multiply the entries of one row by a value, use 2nd [MATH] **4:Matrix J:Row ops 3:mRow(**. For example, you multiply the entries of row 1 by 5 and store them into row 1 with the command **mRow(5,md,1)**.



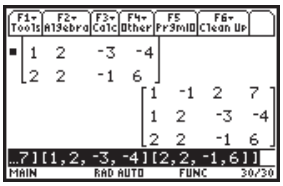
To multiply the entries of one row by a value and add the products to another row, use 2nd [MATH] **4:Matrix J:Row ops 4:mRowAdd(**. For example, you multiply the elements of row 1 by 5, add the products to row 2, and store them into row 2 with the command **mRowAdd(5,md,1,2)**.



These commands don't change matrix **md**; they create a new matrix. You'll probably want to end each command by storing the new matrix with a new name or by replacing **md** with the new matrix, as was done in each of the examples.

Note 6E • Reduced Row-Echelon Form

To convert an augmented matrix to reduced row-echelon form, enter 2nd [MATH] **4:Matrix 4:rref(** and the matrix.



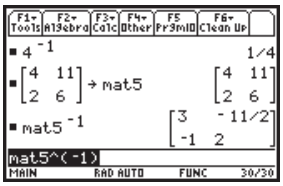
This example shows solving the system

$$\begin{cases} x - y + 2x = 7 \\ x + 2y - 3z = -4 \\ 2x + 2y - z = 6 \end{cases}$$

to get $x = 2$, $y = 3$, and $z = 4$.

Note 6F • Inverse Matrices

To find the inverse of a matrix, raise it to the power of -1.



If you get an **ERROR:Dimension** message, the matrix is not square; if you get an **ERROR:Singular matrix** message, one row of the matrix is a multiple of another row. In either case, the matrix has no inverse.

Note 6G • Graphing Inequalities

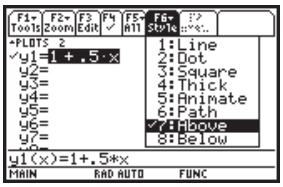
Graphing an inequality is like graphing an equation except you select a graph style to shade above or below the boundary line. The calculator always graphs a solid line for the boundary regardless of the type of inequality.

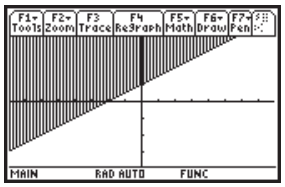
a. Enter the boundary line equation into the Y= Editor screen and press ENTER.

b. Highlight the boundary line equation, then press 2nd [**F6**] (**Style**). (On a TI-92 Plus or a Voyage 200, press F6.)

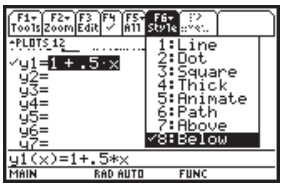
c. Select **7:Above** to shade above the boundary line, or select **8:Below** to shade below the boundary line.

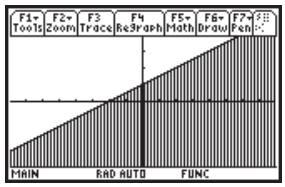
d. Set an appropriate window and then display the graph.





[−7.9, 7.9, 1, −3.8, 3.8, 1]





[−7.9, 7.9, 1, −3.8, 3.8, 1]

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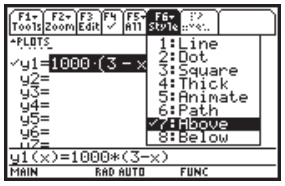
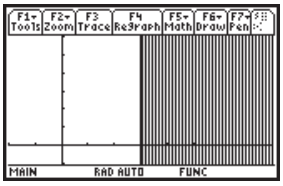
Vertical boundary lines can be approximated with a line of very steep negative slope. An equation in the form $y = 1000(b - x)$, where b is the x-intercept, works well. These screens show an approximation for $x > 3$.





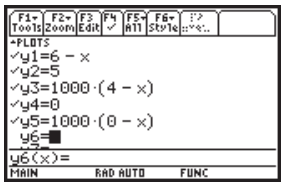
$[-2, 8, 1, -1, 6, 1]$

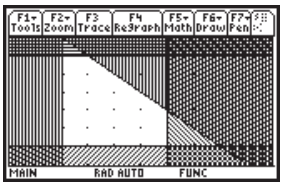
Graphing Systems of Inequalities

When graphing a system of inequalities, it is often easier to do reverse shading so that the feasible region is the area *not* shaded. To do this, shade above the boundary line for the inequalities $<$ and $\leq$, and shade below the boundary line for the inequalities $>$ and $\geq$. Vertical boundary lines can be approximated with a line of very steep negative slope.

These screens show the region defined by the intersection of

$$\begin{cases} y \leq 6 - x \\ y \leq 5 \\ x \leq 4 \\ y \geq 0 \\ x \geq 0 \end{cases}$$





$[-2, 8, 1, -1, 6, 1]$