

Basic Matrix Manipulation with a TI-83 Plus/84 Plus

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.

Throughout the directions, words appearing in **bold** indicate calculator buttons. To learn more about your TI-83 Plus/84 Plus, consult the manufacturer's product manual.

I will be using the TI-83 Plus graphing calculator for these directions. The TI-84 Plus family of graphing calculators is the upgraded version of the TI-83 Plus, with possible extra features in the menus demonstrated below. However, the older TI-83 and TI-82 graphing calculators have slightly different keyboard layouts than the TI-83 Plus, so these directions will not be entirely accurate for those calculators. For example, instead of pressing $2^{nd} \rightarrow$ **MATRIX** to access the matrix menu, just press the dedicated **MATRIX** button.

Inputting/Editing Matrices:

<p>Before we can work with matrices, we must first input them into the calculator. To enter the Matrix Editor, press $2^{nd} \rightarrow$ MATRIX (above the x^{-1} key). The TI-83/84 calculators contain predefined matrix variables labeled [A] through [J].</p>	
<p>The "NAMES" column in the Matrix Editor is where we will choose a matrix after it has been created. The "EDIT" column looks just like the "NAMES" column, except this is where we input or edit a matrix. The "MATH" column contains special commands that only work with matrices, some of which we will discuss later.</p>	
<p>Inputting matrices into the TI-83/84 is easy. Press the right arrow key twice over to the "EDIT" column. Use the UP and DOWN arrow keys to select a matrix name. Let's use [A] since it is already selected, so press ENTER.</p>	
<p>Since we are creating a new matrix, the calculator displays a default 1x1 matrix. Let's say we want a 3x2 matrix instead. Type: 3 \rightarrow ENTER \rightarrow 2 \rightarrow ENTER.</p>	
<p>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 \rightarrow ENTER \rightarrow 2 \rightarrow ENTER \rightarrow 1 \rightarrow ENTER \rightarrow 3 \rightarrow ENTER \rightarrow 8 \rightarrow ENTER \rightarrow 7 \rightarrow ENTER.</p>	

And this is what you should have. Before we can use this matrix, we need to first exit the Matrix Editor. To do this, do not press **CLEAR**! Pressing **CLEAR** will remove the selected number. Instead, press **2nd** → **QUIT** (above **MODE**) to return to the Home screen.

```
MATRIX[A] 3 ×2
[ 4   2 ]
[ 1   3 ]
[ 8   7 ]

3, 2=7
```

Return to the Matrix Editor (**2nd** → **MATRIX**). Notice that [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, right-arrow-key over to “EDIT”, select the matrix name ([A] in this case) and press **ENTER**. The stored matrix will be displayed for editing. Remember to always press **2nd** → **QUIT** to exit the Editor!

```
NAMES MATH EDIT
0: [A] 3×2
1: [B]
2: [C]
3: [D]
4: [E]
5: [F]
6: [G]
7: [G]
```

Adding and Subtracting Matrices:

Enter two matrices into the calculator as shown above, one in [A] and one in [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, select the name in the “NAMES” column and press **ENTER**. This will paste the name onto the Home screen where we can use it.

```
NAMES MATH EDIT
0: [A] 3×2
1: [B] 3×2
2: [C]
3: [D]
4: [E]
5: [F]
6: [G]
7: [G]
```

To add these two matrices together, do the following:
 “NAMES” → select [A] → **ENTER** → + → “NAMES” → select [B] → **ENTER** → **ENTER**

```
[A]+[B]
[ 5  4 ]
[ 4  7 ]
[13 13]
```

If done correctly, you should see this screen.

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

```
[A]-[B]
[ 3  0 ]
[-2 -1]
[ 3  1 ]
```

(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:

<p>Matrix multiplication is easy on the TI-83/84. 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 → multiply key → “NAMES” → select [A] → ENTER → ENTER.</p>	<pre>3*[A] [[12 6] [3 9] [24 21]]</pre>
<p>Multiplying two matrices together is just as easy. However, remember to have the correct matrix dimensions, otherwise the calculator will give a “Dimension Mismatch” 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.</p>	<pre>[A]*[B] [[10 16 20] [10 14 5] [29 44 40]]</pre>
<p>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? At the top of the general MATH menu (press the MATH button under ALPHA), you will find the “Frac” command. Press ENTER to paste it to the Home screen. The calculator will place “Ans” before the command, indicating that the most recent answer will be converted to a fraction. Press ENTER to run the command. Or, we can compress this to one step by adding the “Frac” command at the end before pressing ENTER on the multiplication.</p> <p>Note that fractional scalars must be multiplied to matrices, not divided. That is, $(1/2)[B]$ is correct, but $[B]/2$ will return a “Data Type” error. This is correct since there is no matrix division.</p>	<pre>(1/2)[B] [[.5 1 2.5] [1.5 2 2.5]] Ans>Frac [[1/2 1 5/2] [3/2 2 5/2]] (1/2)[B]>Frac [[1/2 1 5/2] [3/2 2 5/2]] ERR:DATA TYPE 1:Quit 2:Goto</pre>

Calculating the Inverse:

<p>To calculate a matrix inverse, first input $\begin{bmatrix} 5 & 1 \\ 3 & 8 \end{bmatrix}$ as matrix [C] into the TI-83/84. (Of course the matrix must be square, otherwise the calculator will return an “Invalid Dimension” error). Don’t forget to 2nd → QUIT out of the Matrix Editor.</p>	<pre>MATRIX[C] 2 x2 [[5 1] [3 8]] z,z=8</pre>
<p>Select matrix [C] from the “NAMES” column and press ENTER to paste it onto the Home screen. Press the x^{-1} key (under the MATH button) for the inverse command. Press ENTER. Since the answer contains decimal numbers, choosing “Frac” from the MATH menu and pressing ENTER will convert the decimals to fractions.</p>	<pre>[C]⁻¹ [[.2162162162 ... [-.0810810811 ...] Ans>Frac [[8/37 -1/37] [-3/37 5/37]]</pre>

Determinants:

Enter this matrix as matrix [A] in the calculator:

$$\begin{bmatrix} 4 & 2 & 1 \\ 5 & 7 & 2 \\ 1 & -3 & 5 \end{bmatrix}$$

To calculate the determinant of [A], enter the matrix menu and **RIGHT** arrow key over to "MATH". Select the first command, "det(", and press **ENTER** to paste it to the Home screen. Select matrix [A] from "NAMES", press **ENTER** to paste it to the screen, and **ENTER** again to run the command. That's it! The determinant of this matrix is 96.

```
NAMES [MATH] EDIT
1:det(
2:T
3:dim(
4:Fill(
5:identity(
6:randM(
7:augment(

det([A]          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 [A] in the calculator. After pasting [A] to the Home screen from the "NAMES" column, go back to the "MATH" column in the matrix menu and select the second command. Press **ENTER** to paste the command to the screen, and then **ENTER** again to run the command.

```
NAMES [MATH] EDIT
1:det(
2:T
3:dim(
4:Fill(
5:identity(
6:randM(
7:augment(

[A]T
  [[4 5 1]
   [2 7 -3]
   [1 2 5]]
■
```

Deleting Matrices from the Calculator:

Deleting matrices from the TI-83/84 is not too hard, but we must be careful. We will be entering an area of the calculator where we could possibly delete something that we did not intend to. First, press **2nd** → **MEM** (above the "+" key). Choose the second item in the list, which stands for "Memory Management and Delete". Press **ENTER**. Arrow-key down to "Matrix..." and press **ENTER**. You should now see a list of all of the matrices stored on your calculator. Use the **UP** and **DOWN** arrow keys to move the little triangle to the matrix you want to delete, and then press the **DEL** key. Make sure to press **2nd** → **QUIT** to return to the Home screen.

```
MEM
1:About
2:Mem Mgmt/Del...
3:Clear Entries
4:ClrAllLists
5:Archive
6:UnArchive
7:Reset...

RAM FREE 24036
ARC FREE 163840
1:All...
2:Real...
3:Complex...
4>List...
5:Matrix...
6:Y-Vars...

RAM FREE 24036
ARC FREE 163840
▶ [A] 92
  [B] 65
  [C] 47
```