Matrices and the TI-83, TI-83+, and the TI-84

The TI-83 has a matrix key, labeled MATRX. The matrix capability on the TI-83+ and the TI-84 will be found above the x^{-1} key, and will be labeled MATRX or MATRIX. For simplicity, the word MATRIX is used throughout this document.

1. Entering a matrix such as $\begin{bmatrix} 1 & -2 & 3 & 9 \\ -1 & 3 & 0 & -4 \\ 2 & -5 & 5 & 17 \end{bmatrix}$

- **MATRIX $\rightarrow$ EDIT**
- Choose **1:[A].**
- Choose the *size* of the matrix by entering the values where the cursor is blinking. Use 3x4 for our matrix.
- Now *enter each element* of the matrix. Press ENTER after each entry. The cursor moves to the right after each entry.
- When the matrix is entered, go back to the *Home Screen* with **2nd QUIT**.
- To view the matrix in the Home Screen: **MATRIX $\rightarrow$ NAMES $\rightarrow$ [A] $\rightarrow$ ENTER**.

> Note: Whenever we want a matrix name, such as **[A]** , to appear in the home screen, we access the name with this process: **MATRIX $\rightarrow$ NAMES $\rightarrow$ [A] $\rightarrow$ ENTER**. We cannot just type in the **A**.

2. Matrix addition

- To add [A] + [B], the Home Screen will need to look like this: **[A] + [B]**.
- Enter each matrix and then access the matrix names as indicated in the box above.
- To practice adding matrices, let's find [A] + [B], if [A] = $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and [B] = $\begin{bmatrix} 5 & 6 \\ 7 & 8 \end{bmatrix}$.

  The result should be $\begin{bmatrix} 6 & 8 \\ 10 & 12 \end{bmatrix}$.

3. Scalar multiplication

- To multiply a matrix **[A]** by a number, such as 3, your Home Screen should look like this: **3*[A]**.
- To practice scalar multiplication, find 3*[A], if [A] = $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$.

  The result of the scalar multiplication, 3*[A], should be: $\begin{bmatrix} 3 & 6 \\ 9 & 12 \end{bmatrix}$.

4. Matrix multiplication

- To multiply 2 matrices together, such as [A] and [B], the Home Screen should look like this: **[A]*[B]**
  Note that the number of *columns* in the 1st matrix *must* equal the number of *rows* in the 2nd matrix.
- To practice matrix multiplication, find [A]*[B], if [A] = $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$ and [B] = $\begin{bmatrix} 7 & 8 & 9 & 10 \\ 11 & 12 & 13 & 14 \\ 15 & 16 & 17 & 18 \end{bmatrix}$

  Note that [A] is 2 x 3, and [B] is 3 x 4. Since there are 3 columns in [A] and 3 rows in [B], it is possible to multiply [A] x [B].

  The result of the matrix multiplication, [A]*[B] will be the 2 x 4 matrix: $\begin{bmatrix} 74 & 80 & 86 & 92 \\ 173 & 188 & 203 & 218 \end{bmatrix}$

5. Determinant of a matrix

- The **det** can be found in **MATRIX** $\rightarrow$ **MATH**. The first choice is **det**.
- The Home Screen should look like this: **det [A]**
  Note that a determinant can be found for a square matrix only.
- To practice, find the determinant of [A] , if [A] = $\begin{bmatrix} 1 & -2 & 3 \\ -1 & 3 & 0 \\ 2 & -5 & 5 \end{bmatrix}$.
- The result of |A|, the determinant of [A], is 2.

6. Inverse of a matrix

- To find the inverse of a matrix A, the Home Screen should look like this: **$[A]^{-1}$**
- Note that a matrix must be square to have an inverse.
- Note that the exponent, -1, is accessed by pressing the **x^{-1}** key on the calculator.
- To practice, find the inverse of matrix A, if [A] = $\begin{bmatrix} 1 & -2 & 3 \\ -1 & 3 & 0 \\ 2 & -5 & 5 \end{bmatrix}$.

  The result should be $\begin{bmatrix} 7.5 & -2.5 & -4.5 \\ 2.5 & -.5 & -1.5 \\ -.5 & .5 & .5 \end{bmatrix}$.
- To change the entries of the resulting matrix to fractions: **MATH → ►FRAC → ENTER**.

  If the entries are changed to fractions, the result should be $\begin{bmatrix} \frac{15}{2} & -\frac{5}{2} & -\frac{9}{2} \\ \frac{5}{2} & -\frac{1}{2} & -\frac{3}{2} \\ -\frac{1}{2} & \frac{1}{2} & \frac{1}{2} \end{bmatrix}$.

7. Using the inverse matrix to solve a system

- To solve the system
  $$\begin{aligned} 2x - 5y + 5z &= 17 \\ -x + 3y &= -4 \\ x - 2y + 3z &= 9 \end{aligned}$$
  with the inverse matrix method,

  enter [A] = $\begin{bmatrix} 2 & -5 & 5 \\ -1 & 3 & 0 \\ 1 & -2 & 3 \end{bmatrix}$ and [B] = $\begin{bmatrix} 17 \\ -4 \\ 9 \end{bmatrix}$.
- The Home Screen should look like this: $[A]^{-1} * [B]$
- The result is $\begin{bmatrix} 1 \\ -1 \\ 2 \end{bmatrix}$ which means that (1, -1, 2) is the solution to the system.

8. ref and **rref** are found in **MATRIX→MATH.**

To solve a system of equations we can find the reduced row echelon form of a matrix.

The Home Screen should look like this: **rref([A])**

- Find **rref** in **MATRIX → MATH**. Arrow down to **rref**.
- To practice finding the reduced row echelon form, find rref([A]), if [A] = $\begin{bmatrix} -1 & 3 & 0 & -4 \\ 1 & -2 & 3 & 9 \\ 2 & -5 & 5 & 17 \end{bmatrix}$
- The result of the rref([A]) should be: $\begin{bmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & -1 \\ 0 & 0 & 1 & 2 \end{bmatrix}$. So, (1, -1, 2) is the solution.

9. Elementary row operations are found in **MATRIX→MATH.**

After applying each of the row operations below, store the matrix at the original matrix name, by using the **STO►** key at the bottom of the keys on the left of the keyboard.

rowSwap is used to swap rows.
The template is: **rowSwap([matrix name], a row number, the other row number) →[matrix name]**

row+ is used to add one row to another and store the result in the other row**.**
The template is: **row+([matrix name], a row number, the other row number) →[matrix name]**

***row** is used to multiply a row by a constant and store the result in the same row.
The template is: ***row(constant multiplier,[matrix name], row number) →[matrix name]**

***row+** is used to multiply a row by a constant, add the new values to another row, and store the result in the other row. The template is:

***row+ (constant multiplier,[matrix name],a row number, the other row number) →[matrix name]**

We'll start with matrix [A] above: $\begin{bmatrix} -1 & 3 & 0 & -4 \\ 1 & -2 & 3 & 9 \\ 2 & -5 & 5 & 17 \end{bmatrix}$

- Let's get a 1 in the upper left position:
  We'll swap row 1 and row 2 of our matrix [A] and store as a new [A]: **rowSwap([A],1,2)→[A]**
  The result should be:

$$\begin{bmatrix} 1 & -2 & 3 & 9 \\ -1 & 3 & 0 & -4 \\ 2 & -5 & 5 & 17 \end{bmatrix}$$

- Let's get a 0 in the first position of the 2nd row: We'll add row 1 to row 2 and store in row 2, and then store as a new[A]: **row+([A],1,2) →[A]**

  The result should be: $\begin{bmatrix} 1 & -2 & 3 & 9 \\ 0 & 1 & 3 & 5 \\ 2 & -5 & 5 & 17 \end{bmatrix}$

- Let's get a 0 in the first position of the 3rd row: Multiply -2 times row 1 and add the result into row 3, storing in row 3: ***row+ (-2,[A],1,3)→[A]**

  The result should be: $\begin{bmatrix} 1 & -2 & 3 & 9 \\ 0 & 1 & 3 & 5 \\ 0 & -1 & -1 & -1 \end{bmatrix}$

- Let's get a 0 in the 2nd position of the 3rd row: **row+([A],2,3) →[A]**

  The result should be: $\begin{bmatrix} 1 & -2 & 3 & 9 \\ 0 & 1 & 3 & 5 \\ 0 & 0 & 2 & 4 \end{bmatrix}$

- Let's get a 1 in the 3rd position of the 3rd row: ***row(1/2,[A],3)→[A]**

  The result should be: $\begin{bmatrix} 1 & -2 & 3 & 9 \\ 0 & 1 & 3 & 5 \\ 0 & 0 & 1 & 2 \end{bmatrix}$

The final matrix gives the resulting equations:

$$\begin{aligned} x - 2y + 3z &= 9 \\ y + 3z &= 5 \\ z &= 2 \end{aligned}$$