

# Matrix Operations and Mathematica

Matrix operations at times can be difficult and out of hand at times. But using the Mathematica program as a tool will help to alleviate any hardship you may have.

Step 1: Inputting a matrix into Mathematica.



The screenshot shows the Mathematica Student Edition interface. The input cell contains the code: `In[27]:= M1 = {{2, 0}, {0, 3}}` followed by `MatrixForm[M1]`. The output cell shows the list representation: `Out[27]= {{2, 0}, {0, 3}}`. Below that, the output of `MatrixForm` is displayed as a 2x2 matrix: 
$$\begin{pmatrix} 2 & 0 \\ 0 & 3 \end{pmatrix}$$

The first thing you need to do is create your matrix. Start by creating a variable to store your matrix into, as shown above M1 was chosen to store the matrix. You set the variable equal (=) to the desired matrix. Note: The matrix can be any size not just 2x2. The desired matrix must start with a curly bracket ({}), this lets the program know how it needs to store the data. After the first curly bracket you create the first row. This is done by placing another curly bracket and type the row you wish to see. As shown above we have a row {2,0}, followed by another row {0,3}. Which gave us the desired 2x2 matrix. Note: When ending a row or the matrix don't forget to close the brackets (}). Also commas are needed between each number, and between each row.

Once we have created the desired matrix we need to tell Mathematica we want it as a matrix. This is done by the command “MatrixForm[ ]” with your matrix variable name between the closed brackets. Once this is done hit “Shift” and “Enter” at the same time and Mathematica will output the desired result.

Step 2 : Putting a matrix into row reduced echelon form.



The screenshot shows the Mathematica Student Edition interface. The input cell contains the code: `In[29]:= M1 = {{2, 0}, {0, 3}}` followed by `MatrixForm[RowReduce[M1]]`. The output cell shows the list representation: `Out[29]= {{2, 0}, {0, 3}}`. Below that, the output of `MatrixForm` is displayed as a 2x2 identity matrix: 
$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

To put the matrix into row reduced echelon form or RREF, all that needs to be done is to put the command “RowReduce[ ]” into your “MatrixForm[ ]”, and put matrix variable name into “RowReduce[ ]” as shown above. Note: This works for all matrices.

### Step 3: Matrix Identity

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```

```
In[42]:= M1 = {{2, 0}, {0, 3}}
          MatrixForm[M1]
          MatrixForm[IdentityMatrix[2]]

Out[42]= {{2, 0}, {0, 3}}
```

```
Out[43]/MatrixForm=
  ( 2 0 )
  ( 0 3 )
```

```
Out[44]/MatrixForm=
  ( 1 0 )
  ( 0 1 )
```

To find the length of any identity matrix you simply need to type the command “IdentityMatrix[ ]” into the program with the length of the matrix within the brackets. As shown above. This gives the identity matrix for all matrices of the desired length.

### Step 4: Matrix Determinate

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```

```
In[45]:= M1 = {{2, 0}, {0, 3}}
          MatrixForm[M1]
          Det[M1]

Out[45]= {{2, 0}, {0, 3}}
```

```
Out[46]/MatrixForm=
  ( 2 0 )
  ( 0 3 )
```

```
Out[47]= 6
```

To find the determinant of any matrix simply type in the command “Det [ ]” with a matrix variable name between the closed brackets. This will output the determinate of the matrix that was typed between the closed brackets.

## Step 5: Matrix Addition and Matrix Subtraction

```
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In[54]:= M1 = {{2, 0}, {0, 3}}  
        M2 = {{1, 0}, {4, 5}}  
        MatrixForm[M1 + M2]  
  
Out[54]= {{2, 0}, {0, 3}}  
  
Out[55]= {{1, 0}, {4, 5}}  
  
Out[56]/MatrixForm=  
  ( 3 0 )  
  ( 4 8 )
```

For adding two matrices together you first have to have two matrices you wish to add together. Check to make sure they are both the same size matrix (such as 2x2, 3x3, 3x1...etc), if they are not the same size then matrix addition will not work. Once both matrices are prepared simply type in the command "MatrixForm [ ]", have both of the matrices in the closed brackets with an addition sign between them. Hit shift and enter, and Mathematica will output the sum of the two matrices

```
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In[57]:= M1 = {{2, 0}, {0, 3}}  
        M2 = {{1, 0}, {4, 5}}  
        MatrixForm[M1 - M2]  
  
Out[57]= {{2, 0}, {0, 3}}  
  
Out[58]= {{1, 0}, {4, 5}}  
  
Out[59]/MatrixForm=  
  ( 1 0 )  
  (-4 -2)
```

This process works the same for matrix subtraction, with the only difference being a minus sign instead of a plus sign inside the closed brackets.

Note: For matrix addition and subtraction you will always get the same size matrix out as the same sizes that were put in. ex  $2 \times 2 + 2 \times 2 = 2 \times 2$ ,  $3 \times 1 - 3 \times 1 = 3 \times 1$ , ....etc.

## Step 6: Matrix Multiplication

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```
In[1]:= M1 = {{2, 0}, {0, 3}}
        M2 = {{1, 0}, {4, 5}}
        MatrixForm[M1.M2]

Out[1]= {{2, 0}, {0, 3}}

Out[2]= {{1, 0}, {4, 5}}

Out[3]/MatrixForm=

$$\begin{pmatrix} 2 & 0 \\ 12 & 15 \end{pmatrix}$$

```

Matrix multiplication is done by creating two matrices where the columns of a matrix = rows of the other matrix. Create both matrices and store them into a matrix variable name. Then type the command “MatrixForm [ ]” with both matrix variable names inside with an “\*” between them. Press shift and enter, and Mathematica will output the desired multiplied matrix.