

Mathematica for Linear Algebra

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1 Creating functions

We can create a function with the following syntax:

Math: $f(x) = x^2 - 3$

Mathematica: `f[x_] := x^2 - 3`

Now, we might want to find the value of $f(2)$. To do this type: `f[2]`. Or, perhaps we want to use this function to be the argument of another function. Yes, Mathematica can do that. Type: `g[x_] := (f[x])^2 - 5`. Notice that this inserts $x^2 - 3$ for $f(x)$ in our new function $g(x)$.

2 Matrices

There are several ways to enter matrices into Mathematica.

1. Math:

$$A = \begin{pmatrix} 1 & 3 \\ 2 & 2 \end{pmatrix}$$

Mathematica: `A = {{1, 3}, {2, 2}}`

2. Or you can use the *Basic Math Input* window. Just click on the matrix symbol and then on the individual boxes and enter the numbers in the appropriate locations.

Now, the output doesn't *look* like a matrix. Type `MatrixForm[A]` to see the matrix.

Go ahead and create two matrices and multiply them together. To multiply two matrices, use the '.' (period), i.e. `B.C` gives `BC`. When playing around with matrices, you might find the following functions helpful:

`Det[]`, `Transpose[]`, `Inverse[]`, `Eigenvalues[]`, `Eigenvectors[]`, `RowReduce[]`.

We can also have Mathematica solve an $Ax = b$ system. First, let

$$A = \begin{pmatrix} 1 & 2 \\ 3 & 5 \end{pmatrix}, b = \begin{pmatrix} 4 \\ 7 \end{pmatrix}.$$

Go ahead and put these into Mathematica. Then, type: `AppendRows[A, b]`

Now we have added b to the end of A . We can solve this for x using the `RowReduce[]`

function. `MatrixForm[RowReduce[%]]` will give us the RREF of the augmented matrix from which we can read off the solution. The solution is $\begin{bmatrix} -6 \\ 5 \end{bmatrix}$.

3 Solving Systems of Equations

Of course, we don't have to translate our system of equations in to matrix form. Mathematica can solve a given system of equations, as long as the system is not too large. To solve the following system of equations we use the *Solve* function.

Suppose we wanted to solve the following system of equations:

$$2x + y - z = 2$$

$$x - 3y + z = 1$$

$$2x + y - 2z = 6$$

We can do this in Mathematica as follows: `Solve[{2x+y-z==2, x-3y+z==1, 2x+y-2z==6}, {x, y, z}]`

Try solving this same system of equations using matrices.