## Working With Matrices In Excel

To work with matrices in excel, especially with the multiplications and inverse, you have to follow the following steps

1- Select suitable (m x n) block anywhere else in your spreadsheet to receive the expected results on them.

2- Press the "F2" key. • Press the "=" sign

3- Type the matrix function with its arguments.

4- Hold down the keys "Ctrl" and "Shift" at the same time and press the "Enter" key while holding down the other two.

**Example:**

Find the inverse of

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

$A^{-1}$ should now appear in the block of cells you had selected (see screen shot on the right below).

| | A | B | C | D |
|---|---|---|---|---|
| 1 | 2 | -2 | 1 | |
| 2 | 3 | 1 | -1 | |
| 3 | 1 | -3 | 2 | |
| 4 | | | | |
| 5 | =MINVERSE(A1:C3) | | | |
| 6 | | | | |
| 7 | | | | |

| | A | B | C | D |
|---|---|---|---|---|
| 1 | 2 | -2 | 1 | |
| 2 | 3 | 1 | -1 | |
| 3 | 1 | -3 | 2 | |
| 4 | | | | |
| 5 | -0.5 | 0.5 | 0.5 | |
| 6 | -3.5 | 1.5 | 2.5 | |
| 7 | -5 | 2 | 4 | |

If something weird appears (like only one number appearing), you may have pressed the **Enter** key without holding down the **Ctrl** and **Shift** keys. If this is the case re-select the cells you had chosen for your $A^{-1}$ and press the **Delete** key, then repeat the above steps.

If $A^{-1}$ does not exist, e.g. the matrix $B = \begin{pmatrix} 2 & -4 \\ -3 & 6 \end{pmatrix}$ has no inverse since $\det(B) = 0$, you make get something that looks like this:

| | A | B |
|---|---|---|
| 1 | 2 | -4 |
| 2 | -3 | 6 |
| 3 | | |
| 4 | #NUM! | #NUM! |
| 5 | #NUM! | #NUM! |
| 6 | | |

# Example

## Example:

Find the A.C, such that

$$A = \begin{pmatrix} 2 & -2 & 1 \\ 3 & 1 & -1 \\ 1 & -3 & 2 \end{pmatrix}, \quad C = \begin{pmatrix} 1 & 1 \\ 2 & 1 \\ 2 & 3 \end{pmatrix}$$

## Solution

As an illustration, let $A$ be as given above and $C = \begin{pmatrix} 1 & 1 \\ 2 & 1 \\ 2 & 3 \end{pmatrix}$. Since $A$ is a $3 \times 3$ matrix and $C$ is a $3 \times 2$ matrix, the product $AC$ is a $3 \times 2$ matrix. Performing the above steps will give the following screen shots:

| | A | B | C | D | E | F | |
|---|---|---|---|---|---|---|---|
| 1 | 2 | -2 | 1 | | 1 | 1 | |
| 2 | 3 | 1 | -1 | | 2 | 1 | |
| 3 | 1 | -3 | 2 | | 2 | 3 | |
| 4 | | | | | | | |
| 5 | =MMULT(A1:C3,E1:F3) | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | 2 | -2 | 1 | | 1 | 1 |
| 2 | 3 | 1 | -1 | | 2 | 1 |
| 3 | 1 | -3 | 2 | | 2 | 3 |
| 4 | | | | | | |
| 5 | 0 | 3 | | | | |
| 6 | 3 | 1 | | | | |
| 7 | -1 | 4 | | | | |

We are now ready to find the solution to our system of equations.

## Solving the system of Equations

Enter the right-hand-side column vector $\mathbf{b} = \begin{pmatrix} 3 \\ 7 \\ 0 \end{pmatrix}$ into a $3 \times 1$ block of cells in your spreadsheet. Also enter the matrix $A$ into a $3 \times 3$ block of cells in your spreadsheet.

Since we will get the solution from the matrix product $A^{-1}\mathbf{b}$, we first determine the order of the resultant matrix. In this case, we are multiplying a $3 \times 3$ matrix by a $3 \times 1$ vector, we will get a $3 \times 1$ vector.

Select a $3 \times 1$ block of empty cells. Type the following: **F2 = MMULT(MINVERSE(** and select the cells containing matrix $A$. Close bracket **)**. Type a comma and select the cells containing the vector $\mathbf{b}$ and close bracket **)**. You should have something that looks like this:

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | 2 | -2 | 1 | | 3 |
| 2 | 3 | 1 | -1 | | 7 |
| 3 | 1 | -3 | 2 | | 0 |
| 4 | | | | | |
| 5 | | =MMULT(MINVERSE(A1:C3),E1:E3) | | | |
| 6 | | | | | |
| 7 | | | | | |

Hold down the **Ctrl** and **Shift** keys and press the **Enter** key while still holding the other two keys. The values of $x, y$ and $z$ should now appear (see screen shot below).

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | 2 | -2 | 1 | | 3 |
| 2 | 3 | 1 | -1 | | 7 |
| 3 | 1 | -3 | 2 | | 0 |
| 4 | | | | | |
| 5 | | 2 | | | |
| 6 | | 0 | | | |
| 7 | | -1 | | | |

Note that we did not have to calculate $A^{-1}$ separately. We simply asked Excel to calculate it for us and then multiply the inverse by $\mathbf{b}$. Most Excel functions can be nested in this way.

# Matrix determinant

### Example 1 - 2x2 Matrix

The spreadsheet on the right shows a simple 2x2 matrix. The determinant of this matrix can be calculated using the Excel Mdeterm function as follows:

|   | A | B |
|---|---|---|
| 1 | 5 | 2 |
| 2 | 7 | 1 |

=MDETERM( A1:B2 )

This gives the result **-9**.

### Example 2 - 3x3 Matrix

The determinant of the simple 3x3 matrix on the right can be calculated using the following Excel Mdeterm function:

|   | A | B | C |
|---|---|---|---|
| 1 | 6 | 4 | 2 |
| 2 | 3 | 5 | 3 |
| 3 | 2 | 3 | 4 |

=MDETERM( A1:C3 )

This gives the result **40**.