Excel 2007 Array Formulas

(by Dr. Tomas Co 5/7/2008)

Definition:

Array formulas refer to evaluations whose results are placed in a range of cells (instead of a single cell) and are invoked by **[CTRL Shift ENTER]**. A group of brackets will automatically enclose the formula to remind the user that it is an array formula.

Some Excel functions perform matrix operations such as multiplication, inverse and transpose and are implemented as array formulas. There are also other built-in Excel functions, such as LINEST (for linear regression), that require the results be placed in a range of cells, thereby requiring an array formula.

Basic Operations:

1. Naming Arrays

(Avoid using names with one or two alphabets followed by a number, e.g. do not use **F1** or **AB2**, instead use **F_1** or **AB_2**)
   a. Select the range
   b. Method 1:
      - Enter the name in the NW corner area next to the formula entry.
      - Make sure to hit **[ENTER]** (otherwise the action will not be applied)
   c. Method 2:
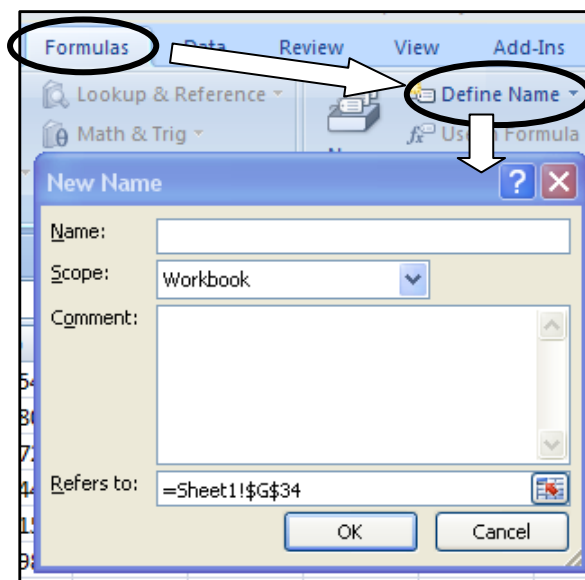   - Go to **[Formula]→[Define Name]** item and then enter the name.

Figure 1. Naming of Arrays or Cells

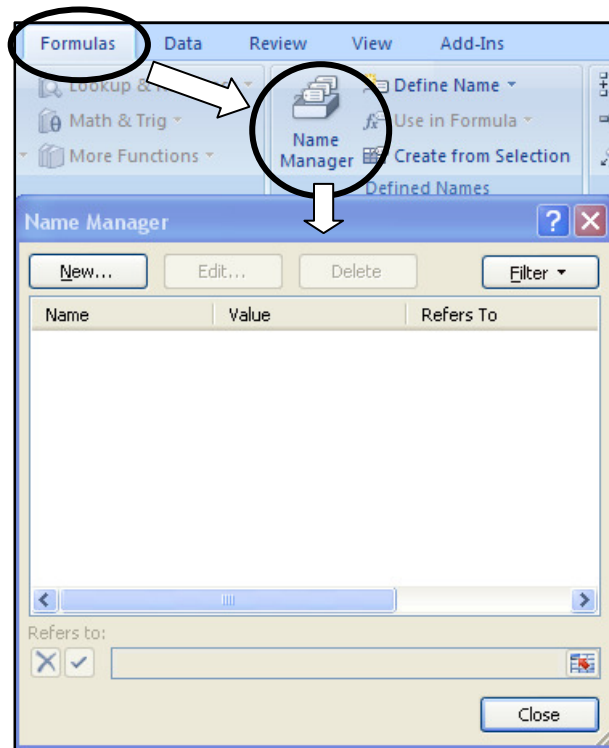To remove names, go to **[Formula]→[Name Manager]** and select the names to be removed.

Figure 2. Name management.

2. Matrix Operations

MMULT	Matrix multiplication
MINVERSE	Matrix inverse
TRANSPOSE	Matrix transpose
MDETERM	Matrix determinant

Example 1: Matrix Multiplication

1. Name the two arrays as **A** and **B.**

Figure 3. Set up matrix *A* and *B.*

2. Select the range for the product.
    (Note: for $C = AB$:

    - the number of columns of A = number of rows of B.
    - the number of rows of A = number of rows of C.
    - the number of columns of B = number of columns of C.)

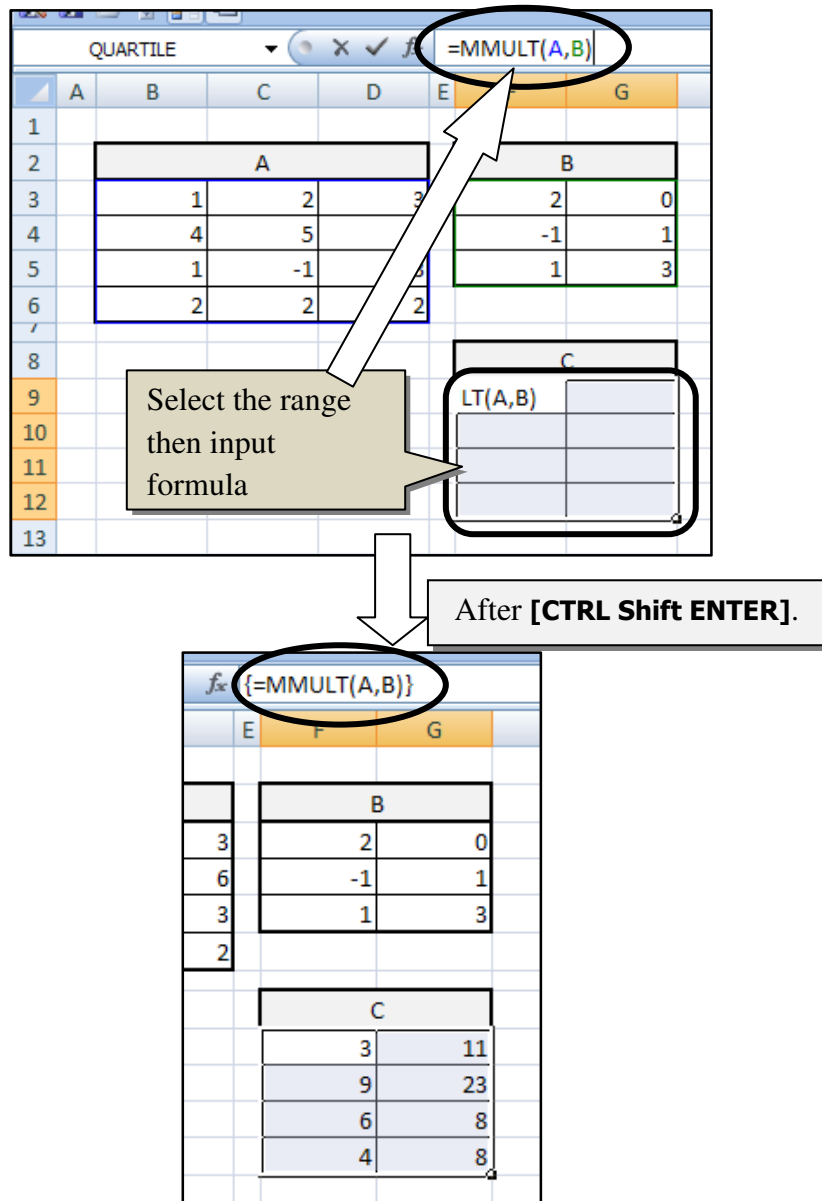3. Input the product formula in the formula area then key in **[CRTL Shift ENTER]**.

Figure 4. Implementing an array formula. After using **[CTRL Shift ENTER]**, a bracket encloses the formula to signify an array result.

Example 2: Solving Simultaneous Linear Equation

Suppose you have the following equations

$$\begin{aligned} 5x + 7y + 3z &= 10 \\ -2y + z &= 3 \\ -3x + 4z &= 5 \end{aligned} \qquad (1)$$

Then we need to first formulate into a matrix equation

$$A\mathbf{s} = \mathbf{b} \qquad (2)$$

where,

$$A = \begin{pmatrix} 5 & 7 & 3 \\ 0 & -2 & 1 \\ -3 & 0 & 4 \end{pmatrix} \ ; \ \mathbf{s} = \begin{pmatrix} x \\ y \\ z \end{pmatrix} \ ; b = \begin{pmatrix} 10 \\ 3 \\ 5 \end{pmatrix}$$

and the solution is then given by

$$\mathbf{s} = A^{-1}\mathbf{b} \qquad (3)$$

1. Setup the range for A and **b,** and name the arrays as **A** and **b**.
2. Select the range for **s**, then enter the formula: **=MMULT(MINVERSE(A),b)** and press **[CTRL Shift ENTER]** as shown in Figure 5.
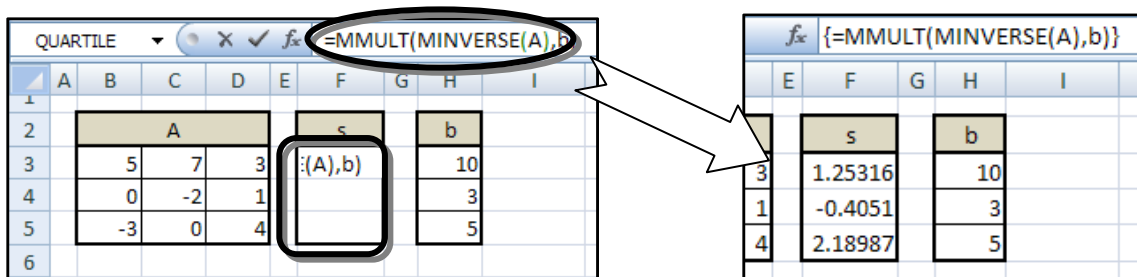

Figure 5. Array function approach for solving simultaneous linear equations.