

Expansion of Factorial Powers

\$1. Usage

1. Execute the Microsoft Excel.

(This application software requires the Microsoft Excel.)

2. Input constants $A[i]$ in the cells of the Microsoft Excel.

(1) When putting a check mark in the check box (i.e. complex number constants):

Each row has a pair of real part and imaginary part of each constants, like $\text{Re}(A[i])$, and $\text{Im}(A[i])$.

Note: Real and/or imaginary part of constant must always be inputted, even 0.

An example is as follows;

	A	B	C	D
1	-22	0	_____	A[1]
2	-1	1.1	_____	A[2]
3	0	2.2	_____	A[3]
4	1.1	-1	_____	A[4]
5	0	0	_____	A[5]
6	3.3	8.7	_____	A[6]
7				
8				
9				
10				

Real part Imaginary part

(2) If NO check mark in the check box (i.e. real number constants):

Each row has a real number constant, like $A[i]$.

An example is as follows;

	A	B	C
1	-22	_____	A[1]
2	-1	_____	A[2]
3	0	_____	A[3]
4	1.1	_____	A[4]
5	0	_____	A[5]
6	3.3	_____	A[6]
7			

3. Press the left mouse button at the upper-left cell and drag the

mouse to the lower-right cell, by holding the mouse button down.

An example is as follows;

(1) When putting a check mark in the check box (i.e. complex number constants):

	A	B	C	D
1	-22	0	_____	A[1]
2	-1	1.1	_____	A[2]
3	0	2.2	_____	A[3]
4	1.1	-1	_____	A[4]
5	0	0	_____	A[5]
6	3.3	8.7	_____	A[6]
7				
8				
9				
10				
11				

Real part Imaginary part


(2) If NO check mark in the check box (i.e. real number constants):

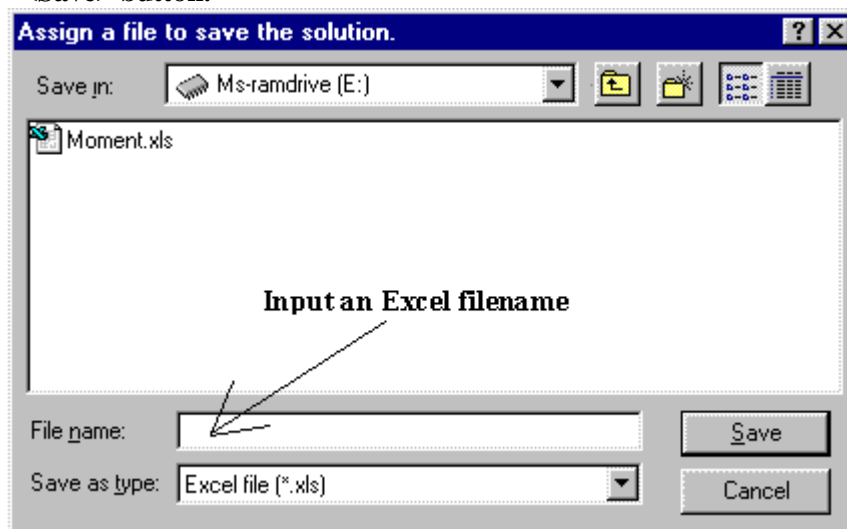
	A	B	C
1	-22	_____	A[1]
2	-1	_____	A[2]
3	0	_____	A[3]
4	1.1	_____	A[4]
5	0	_____	A[5]
6	3.3	_____	A[6]
7			

Note: The above are examples expanding $(Z+A[1])(Z+A[2])\dots(Z+A[6])$.

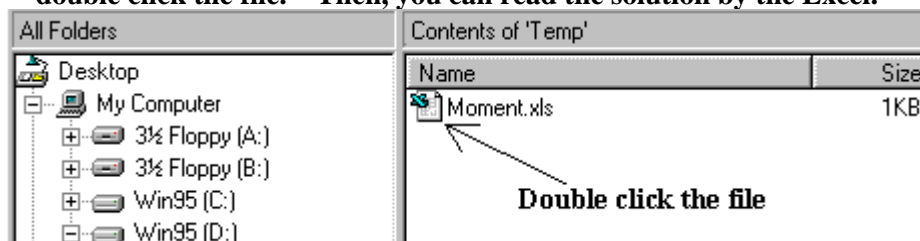
4. Select the Excel menu <Edit> → <Copy>, for copying the data to the clipboard.

Note: In the case of saving the inputted data as an Excel file, first save it at #2 step and then copy it to the clipboard after #3 step.

5. Close the Microsoft Excel.
6. Then, execute this application software, Expansion of Factorized Formula.
7. Press <Expand> button ().
8. A dialog box which prompts to input a filename for saving the solution appears on the screen, if no error occurred.
Input an Excel filename (xxxx.XLS) to save the solution, and then press <Save> button.



9. After saving the solution to the assigned Excel file, a success message appears.
10. Look for the assigned Excel file by using a filer (e.g. Explorer), and double click the file. Then, you can read the solution by the Excel.



The data of the results file are expressed by exponent formats.

The data format can be changed to a standard format by the following procedures;

- (1) Drag the mouse from the upper-left corner to the lower-right corner

- of the whole data area so as the background color being inverted.
- (2) Select Excel menu <Format> → <Cells...>, and select <Number> tab of the dialog.
 - (3) Then, select "General" in the selection box of the dialog, and press <OK> button.

Note: Sometimes, a part of the Excel table has "#####."

In this case, please carry out one of the following two procedures;

- (A) Execute the above (1), (2) and (3) procedures.
- (B) Execute the above (1) and (2) procedures. After that, select "Scientific" in the selection box of the dialog, and set "8" in the "Decimal places" box. Then, press <OK> button.

\$2. Data input to the Excel cells

1. Confirm no data in the Excel cells. Then, press the left mouse button at the upper-left cell and drag the mouse to the lower-right cell, by holding the mouse button down, corresponding to the whole cells in which data are inputted.
2. Select the Excel menu <Format> → <Cells...> → sheet <Number> of a dialog appeared.
3. Select one of the following two processes.
 - (1) In the case of the input by standard numerical value format ;
Select "General" in a selection box of the dialog, and press <OK> button.
In this case, only input by standard numerical value format (e.g. 10, -3, 14.32, -0.03333, etc.) is allowed at the following #4 step.
Allowed characters for inputting are as follows;
0 1 2 3 4 5 6 7 8 9 . -
 - (2) In the case of the input by several numerical value formats ;
Select "Text" in a selection box of the dialog, and press <OK> button.
In this case, input by several numerical value formats (e.g. 12, -3.5, 1.3E-2, -2/3, 3/7E2, 3E-2/7, etc. (*)) is allowed at the following #4 step.
(*) : 3/7E-2 is same as 3/(7E-2), and 3E-2/7 is same as (3E-2)/7.
Allowed characters for inputting are as follows;
0 1 2 3 4 5 6 7 8 9 . - E /

An example is as follows;

	A	B	C
1	-2/3	_____	A[1]
2	-1	_____	A[2]
3	0	_____	A[3]
4	1/3	_____	A[4]
5	1.3E-1	_____	A[5]
6	3.2E3	_____	A[6]
7			

4. Then, start data input to the Excel cells.

\$3. Data to be copied to the clipboard

Followings are key-points for copying the Excel data to the clipboard.

- 1) Copy ONLY the data area to the clipboard. Refer to the following picture.
DO NOT COPY THE NON-DATA AREA TO THE CLIPBOARD.
- 2) A column should not have BLANK cell(s).

	A	B
1		Constants
2	No. 1	1.1
3	No. 2	-3.5
4	No. 3	4.2
5	No. 4	2.8
6	No. 5	-5.6

	A	B	C
1		Constants	
2		Real part	Imaginary part
3	No. 1	1.1	-2.6
4	No. 2	-3.5	1.9
5	No. 3	4.2	0
6	No. 4	2.8	3.4
7	No. 5	-5.6	7.8

\$4. For your reference

$$x^{\underline{n}} = x(x-1)(x-2)\cdots(x-(n-1))$$

$$= \sum_{m=1}^n S_n^{(m)} \cdot x^m$$

$$x^{\overline{n}} = x(x+1)(x+2)\cdots(x+(n-1))$$

$$= \sum_{m=1}^n |S_n^{(m)}| \cdot x^m$$

where

$$S_n^{(m)} = \sum_{k=0}^{n-m} (-1)^k \cdot {}_{n-1+k}C_{n-m+k} \cdot {}_{2n-m}C_{n-m-k} \cdot T_{n-m+k}^{(k)}$$

$$T_{n-m+k}^{(k)} = (1/k!) \cdot \sum_{j=0}^k (-1)^{k-j} \cdot {}_kC_j \cdot j^{n-m+k}$$

$$S_n^{(0)} = 0$$

${}_aC_b$: number of combinations

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