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Advanced Mathematical Operations

ELEC1006: ENGINEERING COMPUTING

Formulas & the Excel Function Library

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- Formulas are used to calculate values in a cell in a worksheet based on values stored in other cells and/or using the Excel function library.
- Examples of Excel functions include SUM, AVERAGE, MEDIAN, SIN, EXP, COSH and PMT.
- There are hundreds of functions available.

Excel's Built-in Functions

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- Math and trigonometry functions.
- Engineering functions.
- Logical functions
- Statistical functions
- Date and time functions.
- Others: Financial functions, Database functions

Math & Trigonometric Functions

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- Elementary math functions: SQRT(x), ABS(x), SUM(range), EXP(x), LN(x), LOG10(x), LOG(x, base), RAND(), PI()
- Trigonometric functions: SIN(x), COS(x), TAN(x), RADIANS(x), DEGREES(x), ASIN(x), ACOS(x), ATAN(x)
- Matrix math functions:

  MMULT(**array1**,**array2**), **SUMPRODUCT**(**arrays**), **MINVERSE**(**array**), **MDETERM**(**array**), **TRANSPOSE**(**array**)

  Note: You can perform matrix addition and subtraction using normal cell operations and hence there are no built-in functions.

Example: Matrix Operations (pre 2019 Excel versions)

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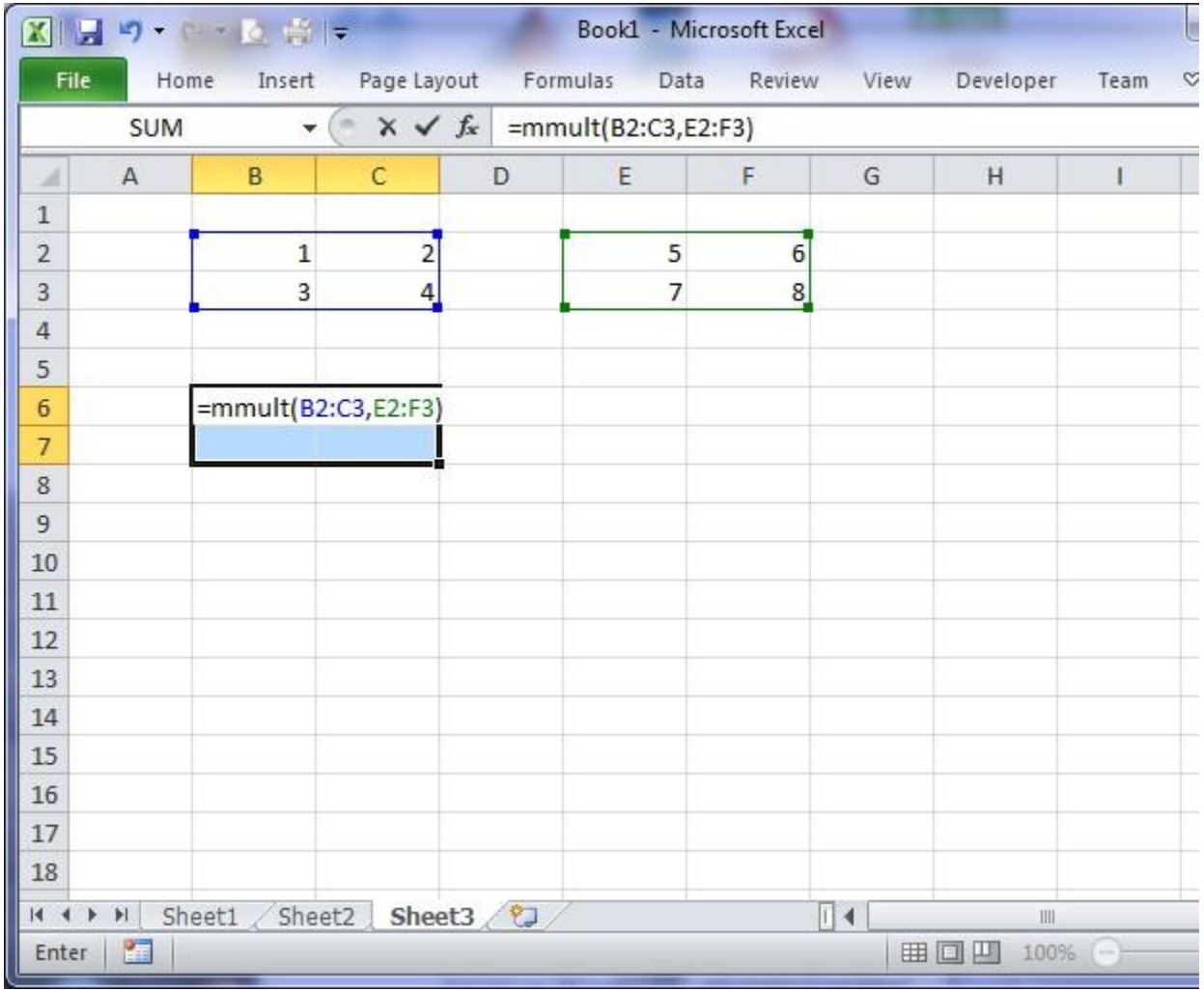

1) **Select the cells** in which the answer will appear (requires the knowledge of size of the solution).
2) Enter the array formula.
3) **Press [Ctrl+Shift+Enter]**.

Example: Matrix Operations Latest Excel

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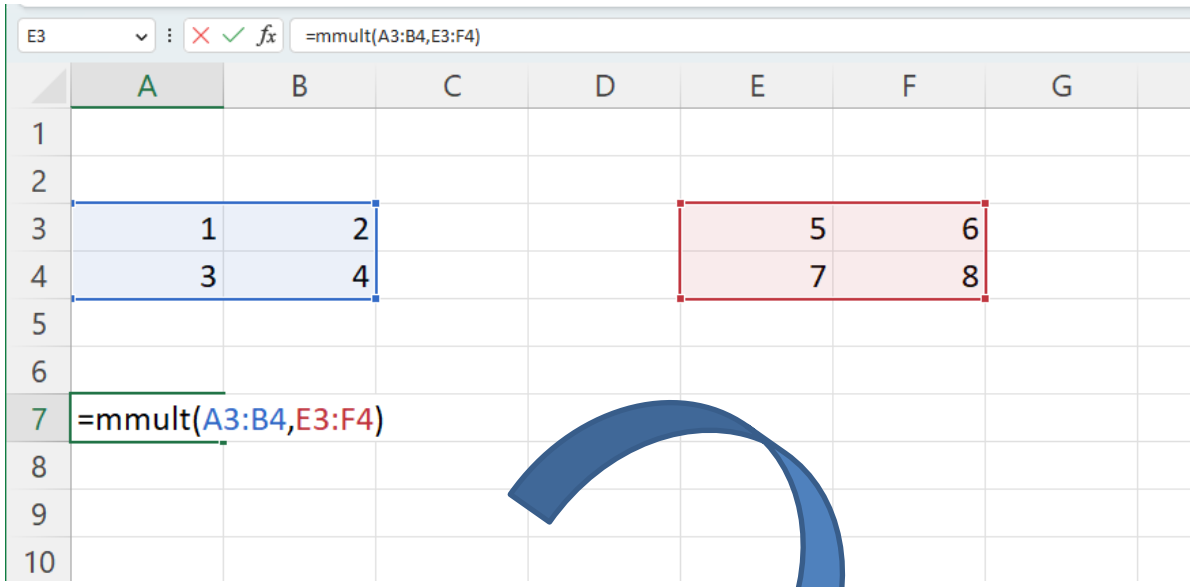
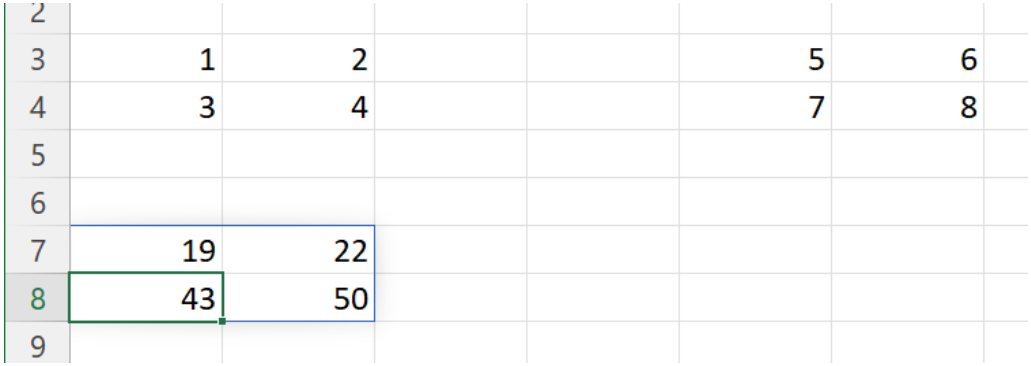


1) **Enter the formula where the results should display.**
2) **Press Enter**



Example 2: Matrix Operations

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	A	B	C	D	E	F	G
1		A			B		
2		1	2		5	6	
3		3	4		7	8	
4		MMULT(B2:C3,E2:F3)			SUMPRODUCT(B2:C3,E2:F3)		
5		19	22		70		
6		43	50				
7		MINVERSE(B2:C3)			SUMPRODUCT(B2:C3)		
8		-2	1		10		
9		1.5	-0.5				
10		TRANSPOSE(B2:C3)			MDETERM(B2:C3)		
11		1	3		-2		
12		2	4				

Complex Numbers in Excel

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- Excel has the capability to do calculations that involves complex numbers.
- Note: **Requires Analysis ToolPack** add-in.
- Help for Complex numbers is available in the Excel Help index under "Engineering Functions“.
- To enter a complex number use the function COMPLEX(_,_).
- E.g. To enter complex number 3+4i, enter =complex(3,4).

Useful Complex Number Functions

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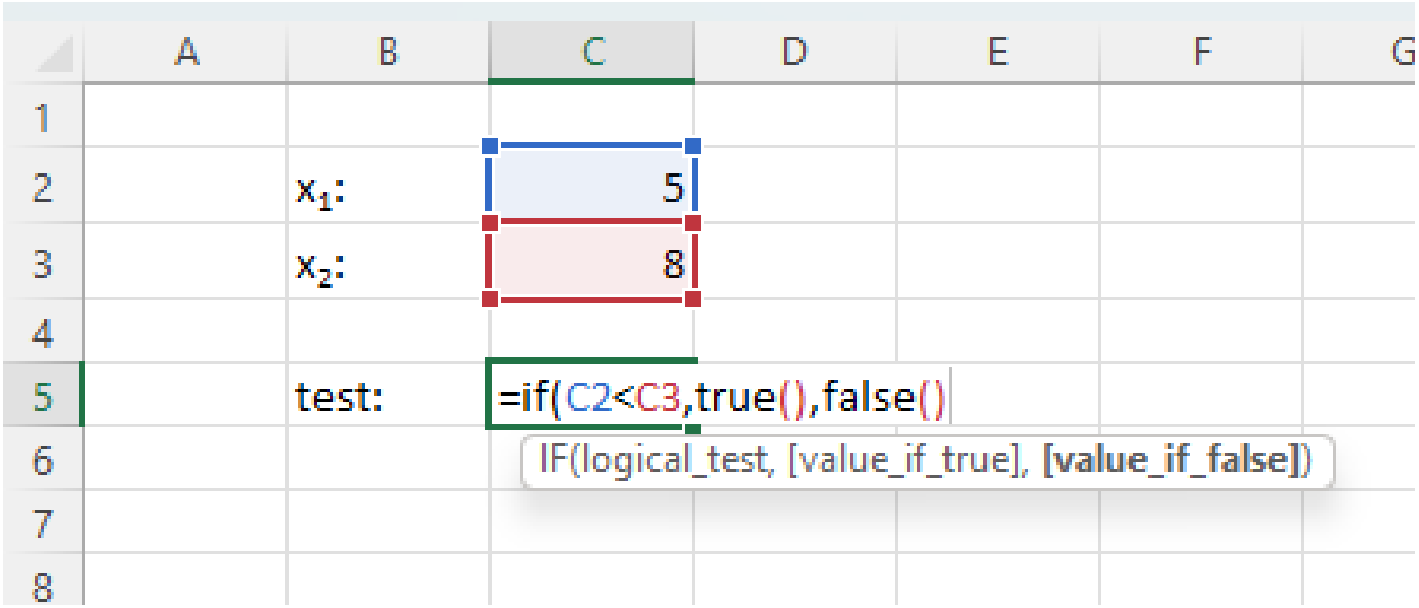
- IMABS(_): magnitude of a complex number
- IMARGUMENT(_), radian angle of a complex number
- IMSUM(_,_), sum of two complex numbers
- IMSUB(_,_), difference of two complex numbers
- IMPRODUCT(_,_), product of two complex numbers
- IMDIV(_,_), complex quotient of two complex numbers
- IMREAL(_), real part of a complex number
- IMAGINARY(_), imaginary part of a complex number

Logical Functions

- Logical functions:
  - **IF(logical_test,value_if_true,value_if_false)**

Example: =IF(C2<C3,TRUE(),FALSE())



Statistical Functions

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- Mean, Median and Mode
- Variance and Standard Deviation
- Errors and Deviation
- Frequency Distributions
- Percentiles and Quartiles
- Deviation and Squared Deviation about the Mean
- Covariance and Correlation Coefficient

More info

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- References
  - Excel online help
  - Number of good books on Excel: e.g. Larsen, R. W. (2021). *Engineering with Excel* (5th ed.). Boston: Pearson.
  - Numerous online resources
- Widely available, learn by using