EML Free Tutorials What is Excel?

Excel is an object (you call it an application) within the Microsoft Office Suite, which is made of several other objects, such as a Workbook that contains one or multiple worksheets and charts. The structure of a worksheet is similar to a 2D matrix, which is made of columns and rows. On the one hand, the columns are designated with letters such as **column A** or **column B**. On the other hand, the rows are designated with numbers, such as **row 1 or row 50**. In Excel 2007 and above, Microsoft has increased the number of columns from 256 to 16,384 columns and increased the number of rows in the worksheet from 65,536 to one million rows.

Excel's User's Interface:



¹ By default, Excel includes one worksheet in each new workbook. The user can change the default number of worksheets by clicking File/ Options/General Tab

² keyboard shortcut (Shift+F11)

³Shortcut (Control + Mouse Wheel)

⁴ To access Excel functions, either click the f_x symbol on the formula box or click on the Formulas Tab to access the Functions Ribbon



EML Free Tutorials Focusing on Home Tab

FILE	HOME	INSER	T P/	AGE LAYOUT	FORMULA	AS DATA	REVIE	W VIEW												
i di	K Cut Copy →	C	Calibri	- 11	• A A	= =	»r -	📴 Wrap Text		Genera	il	Ť	¥					∑ AutoSum ↓ Fill •		
Paste	💞 Format Pain	ter I	в <u>г</u>	J - 🗄 -	👌 - 🛕 -	= = =	€≣∌≣	🗮 Merge & Center	*	\$ -	% *	00, 0, - 0,€ 00.	Conditional Formatting •		Insert	Delete	Format	🗶 Clear 🔻		Find & Select *
C	lipboard	G.		Font	G.		Aligni	ment	G.	1	Number	5		Styles		Cells		Ed	iting	

<u>Clipboard</u> and <u>Font</u> Submenus are common to all MS Office applications (objects) e.g. MS Word and MS PowerPoint; therefore you should be very familiar with these commands. However, some useful shortcuts are included in Excel help files, which can be accessed by pressing F1 then type "shortcuts" in the search box to display all shortcuts. I hope most of you know the following basic shortcuts, if not please make note of them.

Ctrl+C → Copy, Ctrl+V → Paste, Ctrl+X → Cut, Ctrl+N → New Workbook, Ctrl+P → Print, Ctrl+F → Find, Ctrl+Z → Undo, and Ctrl+Y → Redo.

Tidbit: Press Ctrl+D to copy a cell to selected cells below it.

<u>Note</u>: when you copy a cell that contains a formula, you not only are copying the value but also copying the formula and references. More on this issue later.

In the <u>Alignment</u> submenu, I only want to bring your attention to the "Merge & Center" button, which joins selected cells and centers the content in the middle of the new merged cell.



Another important submenu in the Home Tab is the <u>Number</u> submenu, where you can insert a "\$" sign, calculate the "%" of the number inserted in the cell, and increase or decrease the decimal.



The last important submenu is <u>Editing</u>, where you can access preset **Quick Functions**, **Create a Series** and **Clear** a cell's content or format.

∑ AutoSum →	Azv IIII
↓ Fill →	Sort & Find &
ℓ Clear →	Filter * Select *
Edit	ing

1- **Quick Functions**: This list includes Sum, Count, Average, Max, and Min. You can add/change more frequently used functions depending on your usage.

	∑ AutoSum 🝷 Aू	44
Format	∑ <u>S</u> um	nd &
v	Average	ect *
	Count Numbers	
	Max	
	Min	
Q	More Eunctions	T

- A) Starting at Cell B1 enter the following number in one column {5,12,14,5,8}.
- B) The cursor should be now at cell B6, click Σ , notice that Excel entered the sum of the number. Now, practice using the count, average, etc. You can also perform the same operation typing in the following formulae

=sum(B1:B5) \rightarrow syntax =sum(start_cell:end_cell)

=count(B1:B5) \rightarrow syntax=count(start_cell:end_cell)

=average(B1:B5) \rightarrow syntax=average(start_cell:end_cell)

I personally find it easier to use formula instead of the UI, but you are welcome to practice whichever method is more comfortable for you.



Tidbit: If you just want to see the number or the sum without actually carrying out the calculation (i.e. previous steps), you can simply select the cells you desire to perform the previous calculation on and look down beside the Zoom Bar at the bottom of workbook to observe the outcome.



Tidbit: If you would like to change the default calculated functions, Right-Click on the bottom bar and select functions of interest.



2- Fill Function, which you can use to create a series of numbers with a certain pattern. Let's build your first Series using the Fill Function. In Cell C1 insert the first value of the series you wish to create, let's assume it is zero, then make sure you are selecting Cell C1, click the dropdown menu of the select Series, Excel will prompt you with the message shown below. Insert the values shown in the figure and click OK.



3- Clear Function is used to clear the content, format or put comments in selected cells. To

practice, select cells C1:C6 (they should be filled with number from step 2), click dropdown menu and select Clear All, notice all cell contents have been cleared. An alternative to delete the content of a cell or a range is to select the cell or ranges and use the delete key on the keyboard. Note that using the delete key on your keyboard, only deletes the cell contents not the format.

nat	V F	lutoSu ill - llear -	m •		Find & Select •				
	٠	Cle <u>a</u> r	All						
	‰	Clear	<u>F</u> orm	ats					
		Clear Contents							
U	-	Clear Comments							
		Clear	Нуре	rlinks					
	R	Remo	ve Hy	perlinks	;				
	-								

Focusing on the Insert Tab



As a Mechanical Engineer, you are expected to create Charts and Graphs; not only while you are at school but throughout your career. In addition, you must learn the lingo of engineers, which incorporates lots of symbols (this is done to make sure no one else but engineers understand what you are talking about and sometimes not all engineers will understand it either). A good chart, as I fully believe, consists of:

- 1- Appropriate scale on the abscissa and the ordinate, x-axis and y-axis, respectively.
- 2- Axes titles with clearly stated units
- 3- Clearly defined legends (i.e. don't leave it Series1 or Series 2, or any other nonsense title)
- 4- Figure title

<u>Very Important Note</u>: when the problem at hand states to graph the temperature verses voltage (for example) that means: Temperature to be plotted on the y-axis and Voltage to be plotted on the x-axis. Don't forget this tip, it will become very handy, "what is before the **versus** goes on the y-axis and what is after the **versus** lay on the x-axis."

Let's create a good graph together. However, this is may appear to be simple, but I consider it the foundation for all good graphs.

- In Cell B1 insert a series header "Voltage (V)", notice here the title tells you two important pieces of information: (1) the physical quantity you are recording; and (2) the units.
- 2- In Cell C1 insert a series header "Temperature (°C)".
- 3- In cells B2:B7 insert {1,1.5,2,2.5,3,3.5}, of course you can use Fill Series to insert these values. One more trick, if you enter the first two values {1,1.5}, select both cells, then click and drag the lower right corner of the last cell in selected range and move the mouse down till you get all the number of the series.



4- In Cells C2:C7 insert {23.5,32.3,42.6,53,61.8,72.9}. Your workbook should look like:

В	С
Voltage (V)	Temperature (C)
1	23.5
1.5	32.3
2	42.6
2.5	53
3	61.8
3.5	72.9

5- Highlight all the cells from B1:C7, Select the Insert Tab, then select the Scatter Plot from the Chart submenu

HOME INSERT	PAGE LAYOUT	FORM	/ULAS	DATA	REVIEW	VIEW					
Recommended Table PivotTables Tables		Shap The Sma Sma Screen Screen	rtArt	Apps for Office * Apps	Recommend Charts	- XX	► * ★ *	PivotChart	Power View Reports	Line	
▼ : × √	∫ <i>f</i> _x Volt	age (V)					Use this cl	itter (X, Y) o nart type to s	how the	-	
В	С	D	E	F	G	Н	relationsh	ip between s	ets of valu	es.	
Voltage (V) Tem	perature (C)						Click the a	rrow to see t	he differe	nt	
1	23.5							types of scatter and bubble charts available and pause the pointer on the icons to see a preview in your			
1.5	32.3										
2	42.6						document.			· _	
2.5	53									_	
3	61.8										
3.5	72.9										

Then Select Scatter plot type Scatter with Smooth Lines. Excel will create a graph for you. This Excel generated graph needs tons of work to be a "good graph."

HOME INSER	T PAGE LAYOU	T FORMULAS	DATA	REVIEW	VIEW				
ecommended Ta PivotTables Tables			Apps for Office ~ Apps	Recommend Charts	ed ∰ ~ €d ⊕ ~ Cha	<u>14</u> •	PivotChart	Power View	Line Column Win/ Loss Sparklines
Tables		istrations	Abbs		Crid			2	Sparkines
×	$\checkmark f_x$					•••	X	V	
В	С	DE	F	G	н	• • • •	• • • • •	<u>/\\</u>	C I M
Voltage (V)	Temperature (C)					80.0	1.1	Scatter	with Smooth Lines
1	23.5						100		s chart type to: pare at least two sets of
1.5	32.3					Bubble			or pairs of data.
2	42.6					Dubble			·
2.5	53						0.	Use it w	/hen: are many data points
3	61.8					Οõ	00		ata represents a set of x,y
3.5	72.9			80		<u>More</u>	e Scatter Char	pairs ba	ised on a formula.



Now take a good look at the graph below and note the differences, I will show you in class how to transform the above graph to an acceptable graph in our engineering community.



<u>Note</u> if you are writing a report, delete the graph title because the graph title should be placed on the bottom of the figure with the proper figure number.

Smart Tags

A Smart Tag is a small icon that appears automatically in your worksheet after you perform certain actions. Clicking a Smart Tag reveals several options. If it bothers you, you can turn it off, by clicking File /Excel Options/click Advanced Tab/change the controls in the section labeled Cut, Copy and Paste.



EML Free Tutorials Analysis ToolPak and Solver

Analysis ToolPak is an Add-In to Excel that enables engineers to perform some important engineering analysis such as FFT (Fast Fourier Transform) or generating Histograms. Additionally, Solver (another Add-In) is an optimization and equation solving tool. How would you activate the Add-in, Analysis ToolPak? Go to File/Excel Option/Add-Ins Tab, then on the bottom of the window, Manage dropdown menu, select Excel Add-Ins and then click Go.

xcel Options			? ×
General	View and manage Microsoft Office	Add-ins.	
Formulas			
Proofing	Add-ins		
Save	Name *	Location	Type ^
Language	Active Application Add-ins		
Advanced	No Active Application Add-ins		
Customize Ribbon	Inactive Application Add-ins		
	Analysis ToolPak	C:\t\office15\library\analysis\analys32.xll	Excel Add-in
Quick Access Toolbar	Analysis ToolPak - VBA	C:\ffice15\library\analysis\atpvbaen.xlam	Excel Add-in
Add-Ins	Date (XML)	C:\icrosoft Shared\Smart Tag\MOFLDLL	Action
	Euro Currency Tools	C:\15\root\office15\library\eurotool.xlam	Excel Add-in
Trust Center	Inquire	C:\ce15\root\office15\dcf\NativeShim.dll	COM Add-in
	Microsoft Actions Pane 3		XML Expansion Pack
	Microsoft Office PowerPivot for Excel 2013 Power View	C:\dd-in\PowerPivotExcelClientAddIn.dll	COM Add-in COM Add-in
	Solver Add-in	C:\Add-in\AdHocReportingExcelClient.dll C:\oot\office15\librar\solver\solver.slam	COM Add-in Excel Add-in
	Solver Add-in	C:\oot\officet5\library\solver\solver.xlam	Excel Add-in
	Document Related Add-ins		
	No Document Related Add-ins		
	No Document Related Add-ins		
	Disabled Application Add-ins		-
	Add-in: Analysis ToolPak		
	Publisher: Microsoft Corporation		
	Compatibility: No compatibility informat	ion available	
		ft Office 15\root\office15\library\analysis\analy	s32.xll
	-		
	Description: Provides data analysis tool	ls for statistical and engineering analysis	
	Manage: Excel Add-ins 💌 🖸	0	
L [OK Cancel

Click the check boxes beside Analysis ToolPak, Analysis ToolPak – VBA and Solver Add-in then press **OK**.

Add-Ins available:		ОК
Analysis ToolPak - VBA		UK
Euro Currency Tools		Cancel
		<u>B</u> rowse
		A <u>u</u> tomation
	Ŧ	
Analysis ToolPak		
Provides data analysis tools engineering analysis	for st	atistical and

To access the analysis tools from the Analysis ToolPak, go to the **Data Tab** and then select the Data Analysis button. Remember, neither the Analysis ToolPak nor the Solver is activated by default, if you don't follow the steps above you won't be able to access the features.

Image: From Web Image: From Web	FILE	HOME	e inser	T PAGE LA	AYOUT	FORMULAS	DATA	REVIEW	VIEW								
Get External Data Connections Sort & Filter New Group Data Tools Outline D Analysis	From	Web F	rom Other	Existing	Refresh	E Properties	Z S		Reapply	Macros	Text to	Remove Duplicates	🕎 What-If Analysis *	Group	Ungroup	-3	🗄 Data Analysis
occacitational contraction for solution balances of solutions		Get E	External Data		C	Ionnections		Sort 8	k Filter	New Group		Data Tool:	5		Outline	- Fa	Analysis

Once you click Data Analysis, Excel will prompt you with a list of available tools. You will learn how to use some of these during your academic career.

Data Analysis		8 ×
Analysis Tools		
Anova: Two-Factor Without Replication Correlation Covariance Descriptive Statistics Exponential Smoothing F-Test Two-Sample for Variances Fourier Analysis Histogram Moving Average	•	OK Cancel <u>H</u> elp
Random Number Generation	Ŧ	

Let's dig deeper.....

Formula:

We create spreadsheets, in the first place, to automate a set of calculations. Therefore, the spreadsheet is a dynamic environment and the formulas are the building blocks of such environment. Formula entered into a cell:

- 1- Start "=" sign
- 2- Include operator such "+ / *"
- 3- Numbers or text string (yes! You can perform formulas on text)
- 4- Worksheet functions, it is the most interesting to us Engineers.

Early in this tutorial, we introduced some functions (i.e. sum, average, min, max etc.), Excel has a lot more functions, to review more functions go to Excel's Help (press F1) and select Function reference. I advise you to browse through the function reference and read the help file for few functions.

Example: The diameter of a steel shaft is 20 cm, calculate the area in m². (area= $\pi d^2/4$)

Parameter	Value	units
Diameter	20	cm
Diameter	0.2	m
Area	0.03	m²

Parameter	Value	units
Diameter	20	cm
Diameter	=C5/100	m
Area	=PI()*C6^2/4	m²

Tidbit: to show the formulas in a cells press Ctrl+~

Here is a list of common errors that occur when using formulas:

#DIV/0!	Dividing a number by zero.
	Dividing a number by the contents of an empty cell. (xlErrDiv)
#NAME?	Referring to a named range that does not exist.
	Using an Analysis ToolPak function when the add-in is not loaded.
	Using a worksheet function that does not exist (or has been spelt incorrectly).
	Using labels when labels are not allowed.
	Entering text that is not enclosed in double speech marks ("some text").
	Using an invalid cell range reference.
	Referring to another worksheet that does not exist. (xlErrName)
#NUM!	Passing the incorrect argument to a worksheet function.
	The number returned is too big or too small for Excel to recognise it. (xlErrNum)
#REF!	Referring to cells that do not contain any data.
	Referring to cells that may have been deleted.
	Using a Dynamic Data Exchange Link that is not available. (xlErrRef)
#VALUE!	The formula contains a parameter of the wrong datatype, i.e. the formula is expecting an integer but you have passed in some text. (xlErrValue)

Very Important Note: when performing a formula that involves an array, in order to perform the calculation you must press Ctrl+Shift+Enter. For example, let's assume you are to multiply A matrix (3x3) with B matrix (3x1), the resultant matrix is expected to be 3x1:

- Select 3 rows and 1 column
- Type =mmult(A,B)
- Ctrl+Shift+Enter



References:

As you saw in the previous example, the formula references one or more cells. Cell references come in four styles. Creating a good spreadsheet is hinged on proper referencing.

- *Relative Reference:* the reference is fully relative. When the formula is copied, the cell reference adjusts to its new location. Example: A1.
- *Absolute Reference:* the reference is fully absolute. When the formula is copied, the cell reference does not change. Example: \$A\$1.
- *Row Absolute Reference*: the reference is partially absolute. When the formula is copied, the column part adjusts, but the row part does not change. Example: A\$1.
- *Column Absolute Reference*: the reference is partially absolute. When the formula is copied, the row part adjusts, but the column part does not change. Example: \$A1.

Tidbit: To toggle between all four styles of reference, press F4 repeatedly.

Example: The original length of a copper rod is 10 cm, the change in length is monitored in a tensile strength test frame. What is the corresponding stress at each step? Consider the modulus of elasticity, E= 117GPa. (1D Hooke's Law: $\sigma=E\epsilon$)

ω	11415					
	E	117	GPa	E	117	GPa
	original Length	0.1	m	original Length	0.1	m
	ΔΙ	ε	σ (GPa)	ΔΙ	ε	σ (GPa)
	0.0001	0.001	0.117	0.0001	=B6/(\$C\$3)	=\$C\$2*C6
	0.0002	0.002	0.234	0.0002	=B7/(\$C\$3)	=\$C\$2*C7
	0.0003	0.003	0.351	0.0003	=B8/(\$C\$3)	=\$C\$2*C8
	0.0004	0.004	0.468	0.0004	=B9/(\$C\$3)	=\$C\$2*C9
	0.0005	0.005	0.585	0.0005	=B10/(\$C\$3)	=\$C\$2*C10
	0.0006	0.006	0.702	0.0006	=B11/(\$C\$3)	=\$C\$2*C11
	0.0007	0.007	0.819	0.0007	=B12/(\$C\$3)	=\$C\$2*C12
	0.0008	0.008	0.936	0.0008	=B13/(\$C\$3)	=\$C\$2*C13
	0.0009	0.009	1.053	0.0009	=B14/(\$C\$3)	=\$C\$2*C14

You also can reference cells from different worksheets and even from different workbooks. Here is an example of a formula that uses a cell reference in a different worksheet.

=Sheet2!A1+1

This formula calculated the sum of cell A1 in Sheet2 of the workbook and one.

=[workbook_name.xlsx]Sheet1!A1

This formula reference cell A1 from Sheet1 form file workbook_name.xlsx

Names:

Thus far, you refer to cells by their column and row numbers. However, Excel provide us with a very powerful and very useful feature; the ability to provide meaningful names to cells, ranges, columns, rows, even charts and formulas. Ways to assign names to cell and range:

Choose Formulas → Defined Names → Define Names → Define Names to display the New Name dialog box.

🕅 🖯 🏷 🔿	* 📮 =						Boo	ok1 - Excel	
FILE HOME	INSERT PA	AGE LAYOUT	FORMULAS	DATA	REVIEW	VIEW			
	cently Financial	Logical Text	Time - Reference			Name Manager	Define Nar Use in Forr Create fror Defined Name	nula - n Selection	╬□ Trace Prec □샵 Trace Depr K Remove A
E3 👻 :	× <	$f_{\mathcal{K}}$					Define Nam		-
AB	С	D	E F	G	н	I	Define and a	pply names.	L
	New Name: Scope: Comment: Refers to:	Workbook	C\$3:\$E\$10		२ छ ्र E Cancel		Enter des name Select cell range	3	

Remember that no spaces are allowed, for example if you want to name a cell Young Modulus \rightarrow Young_Modulus.

• Ctrl+F3 → displays the Name Manager dialog box (Formulas → Defined Names → Name Manager), then click New button.



• Select the cell or range and then type a name in the Name Box and press Enter.

temp_	values	r :	$\times \checkmark f_x$
	А	В	С
1			
2			
3			
4			
5			
6			

 If the worksheet contains text that you would like to use for names of the adjacent cells or ranges, select the text and the cells to be named and choose Formulas → Defined Names → Create from Selection.

	Qtr-1	Qtr-2	Qtr-3	Qtr-4							
North	80	105	175	311			Name Manager				2
South	85	120	200	322			New	Edit Delete		1	Elter *
East	90	135	225	333			Name	Value	Refers To	Scope	Commer
West	95	150	Create Create	344 Names from v op row eft column ottom row		x	Bast North Qtr_1 Qtr_2 Qtr_4 Qtr_4 South West	("0","15","22","337) ("0","15","15","317) ("00","95","15","315") ("05","150","155","155") ("15","220","25","250", ("11","320","25","35","34") ("15","150","250","34")	-Sheet119C3759787 -Sheet119C357878 -Sheet119C557638 -Sheet119C557638 -Sheet119C557858 -Sheet119755788 -Sheet119758788 -Sheet119C3859788 -Sheet119C385978	Workbook Workbook Workbook Workbook Workbook Workbook	
				ight column							
			-		ж	incel	Refers to:				(
										1	Close

Tidbit: Now you defined an array by the top row and left column, you can use the intersection operator to reference cells i.e. =Qrt_2 South

	Qtr-1	Qtr-2	Qtr-3	Qtr-4	
North	80	105	175	311	
South	85	120	200	322	
East	90	135	225	333	
West	95	150	250	344	
		=Qtr_1 No	rth		

 Naming Constant: let's say you are working on a thermodynamic project and you will use Boltzmann's Constant many times throughout the project (Boltzmann Constant = 1.3806503 x 10-23 m2 kg s-2 K-1). To add boltzmann constant, go Formulas → Define Names→ Define Name → enter data as shown below the press OK. Thereafter, you can use the constant anywhere in the workbook =boltzmann.



Counting and Summing:

1- The last topic in this brief tutorial is counting and summing, I understand that counting and summing was introduced before, but that was the simplest form. How about conditional counting or conditional summing? This is best introduced by examples, for which I refer you to [counting and summing examples.xlsx], I modified this file from *Walkenbach*, J., Excel 2007 Power Programming with VBA, Wiley, 2007.