

Engineering Problem Solving and Excel

EGN 1006 – Introduction
to Engineering



Mathematical Solution Procedures Commonly Used in Engineering Analysis

- Data Analysis Techniques (Statistics)
- Curve Fitting techniques (Looking at Graphs)
- Interpolation techniques
- Single and multiple algebraic equations
- Evaluating Integrals (Evaluate effects over time)
- Economic Analysis
- Optimization (Finding the best solution)

Applicable Engineering Fundamentals

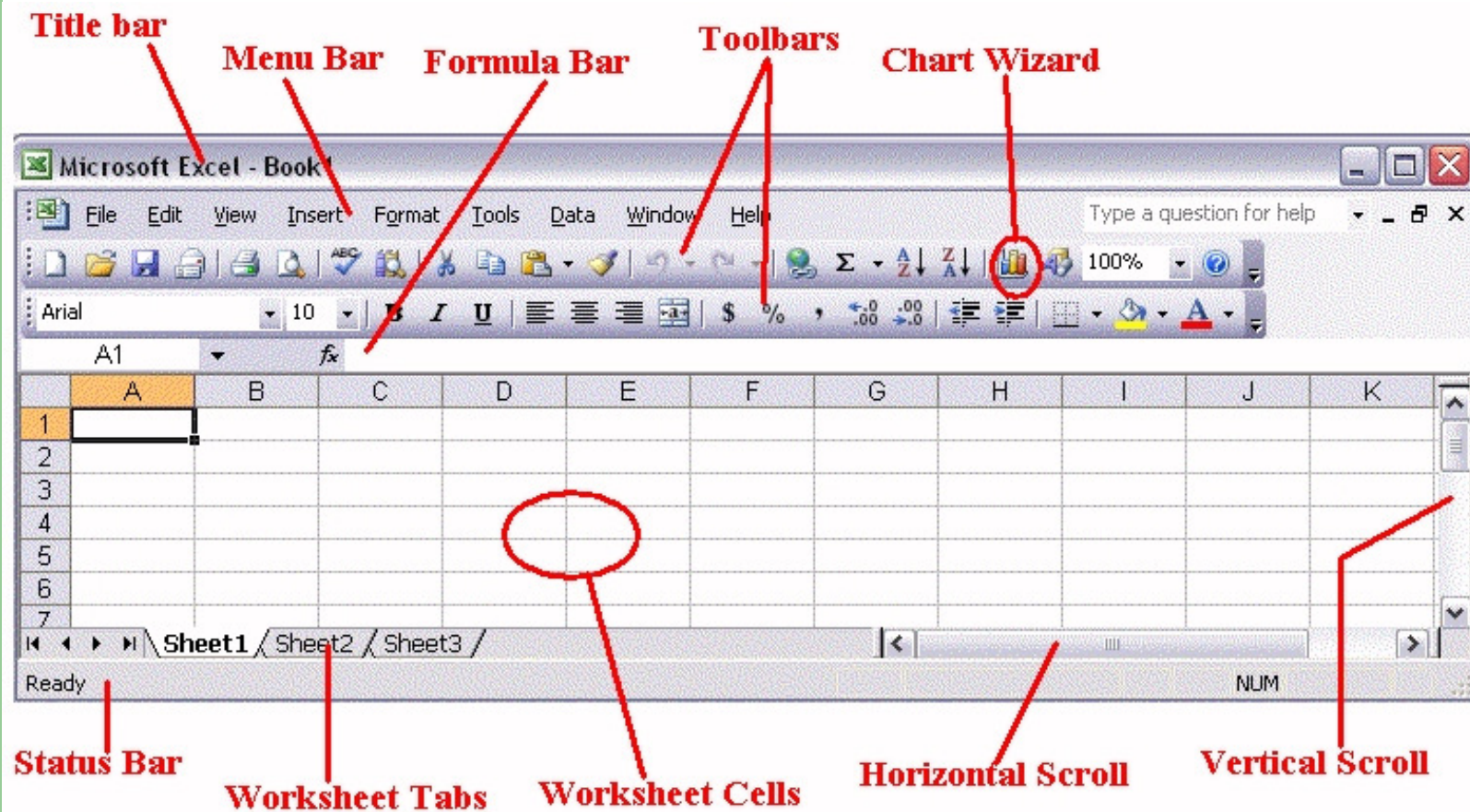
Most engineering problems are based upon one of three underlying principles:

1. Equilibrium – Force, Flux, and Chemical
2. Conservation Laws – Energy and Mass
3. Rate Phenomena – How something changes over time.

What is a spreadsheet?

- A spreadsheet is basically a table containing **NUMERICAL** and/or **ALPHANUMERICAL** values.
- Individual elements are known as **CELLS**.
- Each **CELL** can contain a single value or a **STRING** (sequence of characters)
- The cells are arranged in columns and rows are referenced by a **CELL ADDRESS** (For example, B3 refers to the cell in COLUMN B, row 3.
- The collection of cells is referred to as a **WORKSHEET**.
- A cell can have a manually entered number or be assigned a **FORMULA EVALUATION** such as C7 being $=(C3+C4+C5)$

The Excel Window

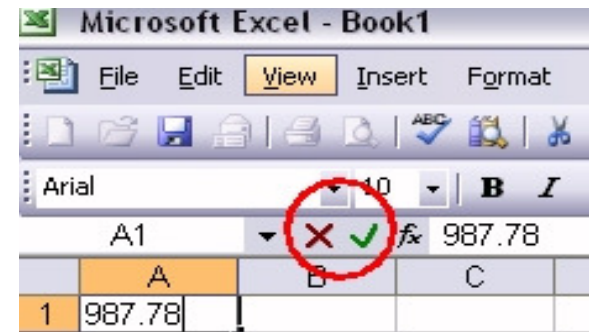


Entering Data

There are two ways to enter data into Excel

- A simple numerical value called a **number constant**.
- A string, called a **text constant**.

When you are finished entering a number in a cell hit ENTER or click the “checkmark”.



Using Formulas

In Excel, a formula **MUST** always begin with an equal sign (=), followed by an expression involving:

- Constants
- Operators
- Cell Addresses

Consider: `=(C3+B2+5)`

- C3 & B2 are cell addresses
- 5 is the numerical constant
- The (+) sign is the operator

This formula could be entered in D7 where the formula would be applied. **Note:** Any change in C3 or B2 will automatically change D7!

Arithmetic Operators

<u>Operator</u>	<u>Purpose</u>	<u>Example</u>
+	Addition	$A1+B1$
-	Subtraction	$A1-B1$
*	Multiplication	$A1*B1$
/	Division	$A1/B1$
^	Exponentiation	$A1^3$
%	Percentage	$A1\%$

Operator Preference

Since some formulas include more than one operator, the question arises as to which one is carried out first. The order is outlined to the right. If any formula has two operators from the same group, the order is carried out from left to right.

Operator Preference	Operator
1	%
2	^
3	* and /
4	+ and -

For example, in the formula $=(C1/D2*E3)$, the division would be carried out first then multiplication.

Using Functions

Excel includes many different functions which can carry out a wide variety of operations.

They include:

- Mathematical and statistical operations
- Process financial data
- Process AND return text information

Each function has a specific name followed by an **ARGUMENT** enclosed in parenthesis.

Function Examples

- =Sum(C1,C2,C3) This will add the numbers in the three cell addresses. The ARGUMENT is inside the parenthesis and separated by commas.
- =Sum(C1:C50) the use of a COLON indicates a RANGE and will add up ALL cells between the two cell addresses.

A Simple Spreadsheet Application

A small machine shop has the following parts on hand:

Item	Quantity
Screws	6500
Nuts	9000
Bolts	5400

Start by creating a worksheet that includes this information, plus the total number of parts on hand. Answer the questions on the worksheet provided.

A tip of the trade

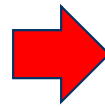
Time(s)	Distance(m)	Velocity
10	5	=B2/A2
20	15	
30	22	
40	36	
50	44	
60	52	
70	69	
80	78	
90	91	
100	106	

A formula can be copied by highlighting the cell and placing the mouse in the bottom right corner of the cell until a “+” appears.

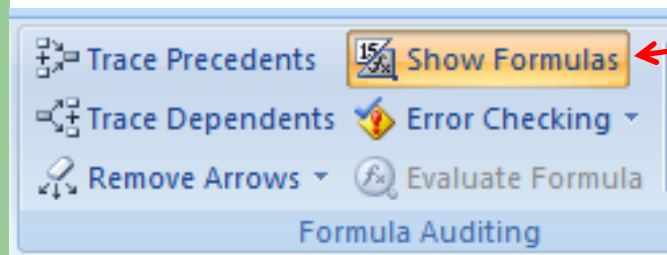
With the mouse drag the “+” down to all the cells where you want the formula to be copied and hot enter. Excel will automatically change the cell address for you.

A tip of the trade

Time(s)	Distance(m)	Velocity
10	5	0.5
20	15	0.75
30	22	0.7333333333
40	36	0.9
50	44	0.88
60	52	0.8666666667
70	69	0.985714286
80	78	0.975
90	91	1.011111111
100	106	1.06



Time(s)	Distance(m)	Velocity
10	5	=B2/A2
20	15	=B3/A3
30	22	=B4/A4
40	36	=B5/A5
50	44	=B6/A6
60	52	=B7/A7
70	69	=B8/A8
80	78	=B9/A9
90	91	=B10/A10
100	106	=B11/A11



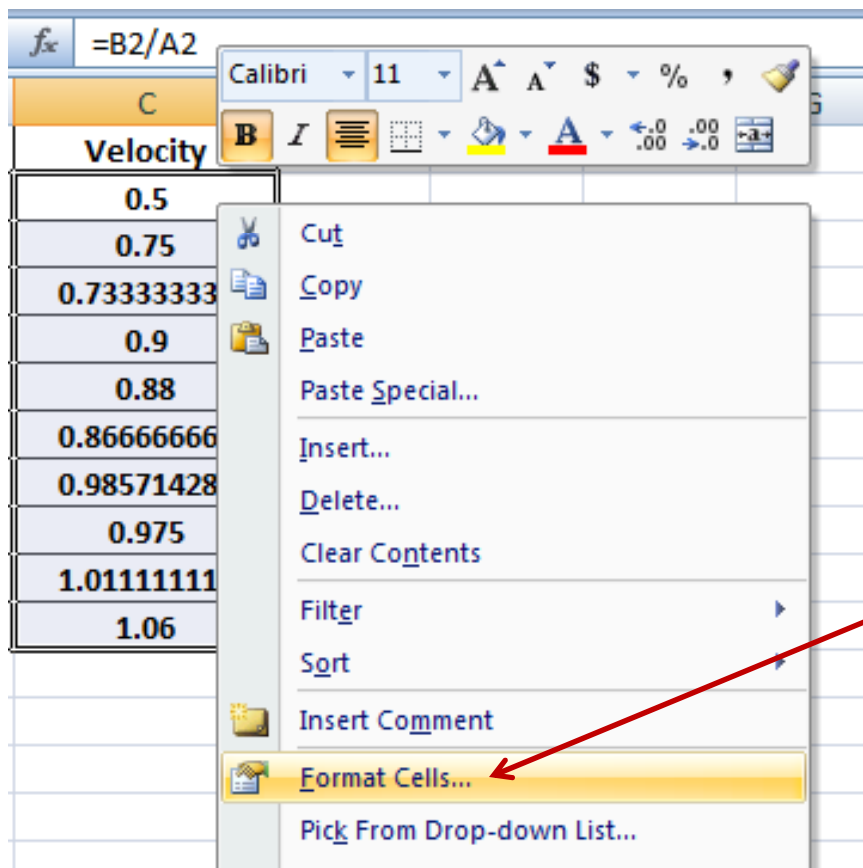
To view formulas simply go to the formulas tab and click “show formulas” under formula auditing.

Another tip of the trade

Time(s)	Distance(m)	Velocity
10.0	5.0	0.5
20.0	15.0	0.75
30.0	22.0	0.7333333333
40.0	36.0	0.9
50.0	44.0	0.88
60.0	52.0	0.8666666667
70.0	69.0	0.985714286
80.0	78.0	0.975
90.0	91.0	1.011111111
100.0	106.0	1.06

Suppose the data you enter has ONE decimal place and the calculated values do not. Is there a way to change the **FORMAT** of the calculated values?

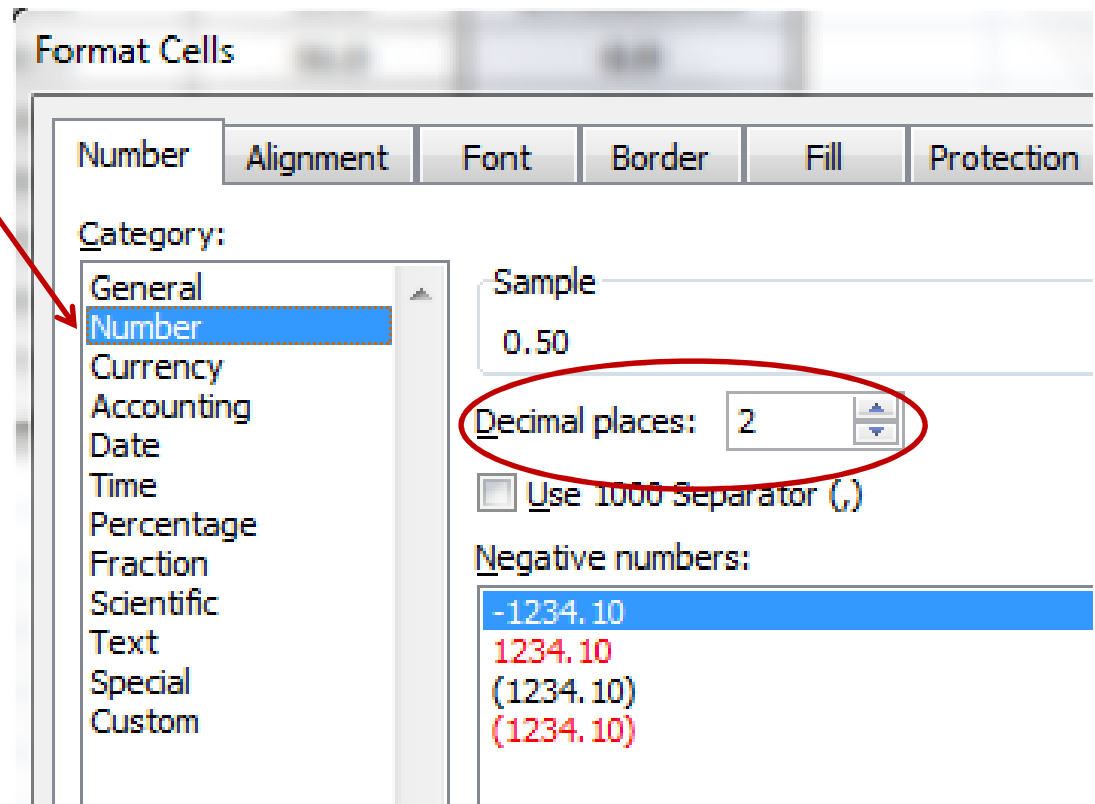
Another tip of the trade



Highlight the data you want to format and RIGHT CLICK with the mouse. Choose **FORMAT CELLS from the menu.**

Another tip of the trade

Choose **NUMBER**, then change the number of decimal places to match your entered data. In this case, **ONE**.



Another tip of the trade

A	B	C
Time(s)	Distance(m)	Velocity
10.0	5.0	0.5
20.0	15.0	0.8
30.0	22.0	0.7
40.0	36.0	0.9
50.0	44.0	0.9
60.0	52.0	0.9
70.0	69.0	1.0
80.0	78.0	1.0
90.0	91.0	1.0
100.0	106.0	1.1

Other function examples

- =SQRT(x) Takes square root of “x”
- =Min(x1:x20) Returns the minimum # in the set
- =Max(x1:x20) Returns the maximum # in the set
- =Round (x,n) Rounds “x” to n decimal places
- =Average (x1:x15) Returns the average

Example: =sum(A1, SQRT(A2/2),2*B3+5,D7:D12)

This example has **FOUR** arguments as evidenced by the commas

Example #2 – Student Exam Scores

Create the following worksheet: [See paper worksheet](#)

Student	Exam 1	Exam 2	Final Exam	Overall Score
Davis	82	77	94	
Graham	66	80	75	
Jones	95	100	97	
Meyers	47	62	78	
Richards	80	58	73	
Thomas	74	81	85	
Williams	57	62	67	

And ANOTHER tip of the trade – ABSOLUTE addressing

A	B	C	D
Weight (N)	Force(N)	Length1 =	0.25
5	$= (A2 * D1) / D2$	Length2 =	0.13
5.3			
5.9			
6.2			
6.8			
7.4			
8.5			

Suppose we have a situation like this. The force is found by multiplying the weight by length 1 then dividing that total by length 2. **What would happen if we dragged the formula cell down?**

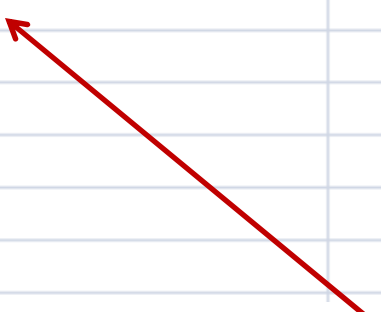
And ANOTHER tip of the trade – ABSOLUTE addressing

A	B	C	D
Weight (N)	Force(N)	Length1 =	0.25
5	$= (A2 * D1) / D2$	Length2 =	0.13
5.3	$= (A3 * D2) / D3$		
5.9	$= (A4 * D3) / D4$		
6.2	$= (A5 * D4) / D5$		
6.8	$= (A6 * D5) / D6$		
7.4	$= (A7 * D6) / D7$		
8.5	$= (A8 * D7) / D8$		

Notice that the formula is now incorrect in cells B3 – B8

And ANOTHER tip of the trade – ABSOLUTE addressing

A	B	C	D
Weight (N)	Force(N)	Length1 =	0.25
5	$=A2*\$D\$1)/\$D\2	Length2=	0.13
5.3	$=A3*\$D\$1)/\$D\2		
5.9	$=A4*\$D\$1)/\$D\2		
6.2	$=A5*\$D\$1)/\$D\2		
6.8	$=A6*\$D\$1)/\$D\2		
7.4	$=A7*\$D\$1)/\$D\2		
8.5	$=A8*\$D\$1)/\$D\2		



To fix this problem we use the “\$” sign in front of both the ROW and COLUMN. This creates an absolute address which is fixed in nature.

Moving things around!

You can:

- Select and Highlight a block of cells
- Copy a block of cells
- Move a block of cells
- Delete rows or columns
- Create grids
- Change font color, fill in backgrounds, etc
- Adjust column widths