

## Method Sheet 101

### Basic data handling using Microsoft Excel

#### Overview

This method sheet explains how to perform basic data handling tasks using Microsoft Excel. The advice should be applicable to most equivalent spreadsheet applications.

#### The basics of cell referencing

- 1) Microsoft Excel organises data in the form of large tables of individual squares, called cells, each of which can contain a number, a text string or a function (formula).
- 2) Users can enter data into cells by clicking on the cell then typing in the cell box itself, or in the text input box at the top of the screen.
- 3) Each table of cells is called a worksheet, selected by tabs at the bottom of the page.
- 4) Every cell in the worksheet has a unique reference ID based on the row number and column letter.
- 5) For example, the top left cell of the sheet, which is in the first column (A) and the first row (1), is designated cell A1

#### Simple addition and subtraction

- 1) Users can instruct any cell to display or use the data from any other cell by typing a formula, which always begins with the equals '=' symbol.
- 2) After the equals symbol, a formula containing references to the other cell(s) can be typed.
- 3) For example, you can instruct cell A5 to display the value already present in cell A1 by typing the following function into cell A5: =A1
- 4) The values of a cell can be added or subtracted from another cell using the '+' and '-' functions, for example:

Addition: =A2+B2

Subtraction: =B2-A2

- 5) The first of these formulas would display the result of adding the values in cells A2 and B2 together, and the second would show the result of subtracting the value in A2 from that in B2, as shown below:

Addition function

	A	B	C
1			
2	2	3	5
3			

Subtraction function

	A	B	C
1			
2	2	3	1
3			

Double clicking on a cell

	A	B	C
1			
2	2	3	=B2-A2
3			

- 6) Note that double clicking on a cell reveals the formula within the cell box, and also usefully highlights in different colours all the cells it refers to (see above).

## Copy, paste and drag to fill

- 1) Right clicking on a cell reveals the edit menu, from which you can select the Cut, Copy and Paste options to copy values or formulas to any other cell.
- 2) Alternatively, you can use the following keyboard shortcuts:  
Cut: Ctrl and X                      Copy: Ctrl and C                      Paste: Ctrl and V
- 3) A very useful Excel shortcut is the 'Drag to fill' function.
- 4) Click and hold the green "Fill handle" button which is present at the bottom right of any selected cell (see example below).
- 5) Drag the fill handle button horizontally or vertically to highlight as many cells as you like to copy the formula into.
- 6) When you let go of the mouse button, the cells you highlighted will be filled with the same formula that was present in the cell you are copying from.

Selecting drag to fill						Cells after drag to fill					
	A	B	C	D	E		A	B	C	D	E
1						1					
2	1	2	3	4	5	2	1	2	3	4	5
3						3					
4	=a2					4	1	2	3	4	5
5						5					

- 7) Note that if you want to drag to fill in both rows and columns, you must do one or the other first, let go of the mouse button, then select it again to go in the other direction.

## Absolute and relative cell referencing

- 1) A key aspect of data handling you need to learn when working with spreadsheets is the difference between absolute and relative cell referencing.
- 2) By default, when you use a formula containing a cell reference, Excel assumes you mean the **relative cell reference**.
- 3) For example, if you type the function =A1 into cell C4, Excel will interpret that as "show the data in the cell that is two rows above and three columns to the left of this cell".
- 4) What this means is, when you copy this =A1 function from cell C4 into other cells, they will NOT always show the value present in cell A1, instead they will display the value in the cell that is two rows above and three columns to the left of this cell - this is what is meant by a relative cell reference.
- 5) Analysis of drug screening data often requires background correction, which means subtracting the same value from every measurement across a whole 96-well plate.
- 6) To achieve this, we must specifically instruct Excel to not use a relative cell reference, but instead use an absolute cell reference.
- 7) Let's imagine that the baseline value we want to subtract from every cell in a table of values is present in cell A1.
- 8) To ensure Excel always subtracts the value from that cell, and not any other cell, we use the **absolute cell reference**, defined using dollar symbols:

=A\$1

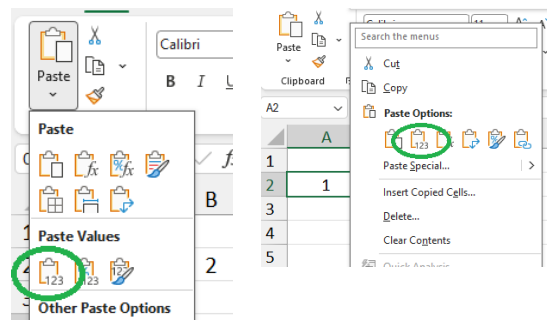
- 9) Here, the first dollar symbol says, always use column A, and the second dollar symbol says, always use row 1.
- 10) Only after you add the dollar symbols can you use the drag to fill function, or copy and paste into other cells, ensuring the new cells to point to the same cell afterwards.
- 11) In the example below, the entries in the upper row (row 2) are values only (just numbers, no functions), the left hand panel shows the results of copying relative cell references across row 4, and the right hand panel shows the results of copying absolute cell references across row 4, as can be seen, in the right hand panel (using dollar symbols), the reference is always to cell A2

Using relative cell references						Using absolute cell references					
	A	B	C	D	E		A	B	C	D	E
1						1					
2	1	2	3	4	5	2	1	2	3	4	5
3						3					
4	=A2	2	3	4	5	4	=\$A\$2	1	1	1	1

- 12) Another key point to remember is that the Cut and Copy functions work differently with cell references in Excel.
- 13) If you Copy then Paste (or drag to fill) formulas which do not have dollar signs from one cell to another, Excel will copy the relative cell reference.
- 14) On the other hand, if you use Cut then paste with a relative reference, Excel will transplant the cell reference as it was in the first cell, so that it still points to the original target cell but from the new location, even without dollar signs.

## Paste normal and Paste values

- 1) Another key property you need to become familiar with when using spreadsheets is the use of the Paste normal and Paste values options.
- 2) When you use Ctrl V, or the simple Paste option directly from the Edit menu, Excel assumes you want to use the default, Paste Normal setting.
- 3) In this mode, Paste Normal will transfer any formulas that may be present in the cell you are copying from, and the cell you are copying to will then apply that formula to perform whatever calculation is necessary in that location.
- 4) If, after copying as normal, you select Paste Special and then choose the Values option, Excel will paste whatever the numerical result of the formula was in the cell you are copying from.
- 5) When using Paste Values, the formula is stripped away, leaving only the number that was displayed in the cell you are copying from (e.g., 0.454, but not =A12-A1).
- 6) There are a number of ways of choosing to paste as values.
- 7) You can click the pulldown arrow at the bottom of the Paste button at the top of the screen on the Home ribbon, then select the '123' icon below Paste Values.
- 8) Or you can right click the target cell, then select the '123' icon below Paste Options, or Paste Special then Values.



### Using the SUM and AVERAGE functions

- 1) When analysing drug screening data, you will often have to calculate the sum of values from a number of cells, or calculate the mean of those values.
- 2) We can use the SUM and AVERAGE functions for these calculations.
- 3) For example, to calculate the sum of 3 cells A2 to C2, we can use =SUM (A2 : C2)
- 4) Likewise, to calculate the mean of these cells, we can use =AVERAGE (A2 : C2)

=SUM (A2 : C2)

	A	B	C
1			
2	1	2	3
3			
4	6		

=AVERAGE (A2 : C2)

	A	B	C
1			
2	1	2	3
3			
4	2		

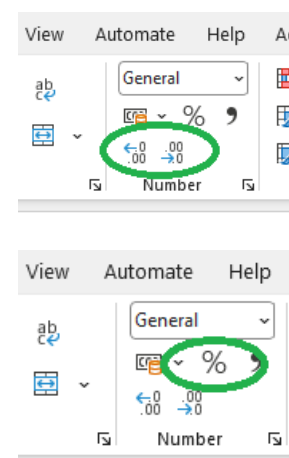
- 5) Note that the AVERAGE function calculates the mean of the values you select, if you want to calculate the median, use =MEDIAN (A2 : C2)
- 6) *Tip:* After typing the function (e.g. SUM) and the opening bracket, you don't have to type the cell IDs by hand, you can simply select all the cells you want to use in the formula by highlighting them with the mouse, then finish the formula by typing the right hand bracket.

### Multiplication and division

- 1) To multiply the value in one cell by that in another, use the asterisk function (\*, shift 8 on most UK keyboards), for example: =C2\*A2
- 2) To divide the value in one cell by that in another, use the forward slash function (/), for example: =C2/A2

### Formatting of numbers

- 1) To increase or reduce the number of digits shown after the decimal place, highlight the relevant cells, then use the Increase and Decrease Decimal function in the Home ribbon at the top of the screen.
- 2) To change the display from a numerical value to a percentage, click on the % icon in the Home ribbon.
- 3) After selecting the percentage option, Excel will show values such as 0.519 as 51.9%.
- 4) You do not have to multiply by 100, as Excel will do this automatically to the displayed value, but not the actual value in the cell, which will remain as 0.519 in this example.



## Calculating the Standard Deviation

- 1) It is frequently necessary to check how reproducible the measurements of an experiment were between different replicates of the same treatment.
- 2) We can gain insight into how much variation there is between the different replicates by calculating the **standard deviation** of the set of values.
- 3) Standard deviation is a statistical measure of how tightly clustered the values are around the mean.
- 4) A high standard deviation means the values are spread out far from each other, so reflecting poor assay reproducibility.
- 5) A low standard deviation means the values are all close to each other, reflecting good assay reproducibility and giving us more confidence in the validity of the data.
- 6) These values are also commonly used to generate the error bars shown on bar charts.
- 7) You can calculate the standard deviation (SD) of a group of cells using the STDEV function, for example: `=STDEV (A2 : E2)`
- 8) *Tip:* To calculate the standard error of the mean (SEM), simply calculate the SD first, then divide this value by the square root of the number of individual experiments or measurements (the 'n').

## Notes

- It will help to practice each of these functions to better understand how they each work before beginning the analysis of your project data.
- For advice on how to name your Excel files and structure your project data folders, please see the advice in **Method Sheet 17** on Data Management and Integrity.

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