Contents

1 Values and Formulas

The power that drives the Excel spreadsheet derives from the formulas and functions in the individual cells. We begin our review of these by examining the values and formulas that may be stored in the cells, and see how Excel can assist in handling these.

Cell Contents

However simple or complex the spreadsheet, its cells will contain one of three possibilities:

- **l**   **Label**   **Some form of text**
- **v**   **Value**   **Number, with formatting**
- **b**   **Blank**   **Empty cell**

Review the cells in this example spreadsheet:

The cells are displayed with their associated formatting applied. For example, the numbers in cells A3:B6 are displayed as dates.

To see the actual contents of the cells:

1   Press **Ctrl** + ` (the grave accent key) or select the **Formulas** tab and click **Show Formulas**

The actual contents of the cells, as entered, are displayed:

To check the type of cell content, you use the **CELL** function – e.g. to get the type of cell **C3**:
=CELL("type",C3)

This shows the cell contents as entered. For a date, the entered value is converted to the number of days since January 1st, 1900.

Numbers in the cells are displayed according to the cell format that has been assigned. The same value can appear in many different ways – for example:
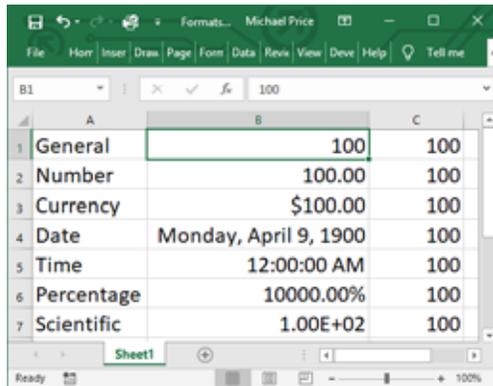
The value 100 in cell B1 is copied to cells B2 to B7, and a different numeric format is applied to each cell.

The number 100 takes on significantly different appearances, depending on the format applied. However, when the cell contents are referenced, the same underlying value is assigned, irrespective of the format.

1 Press **Ctrl + `**, or select the **Formulas** tab and click **Show Formulas** to show the actual contents
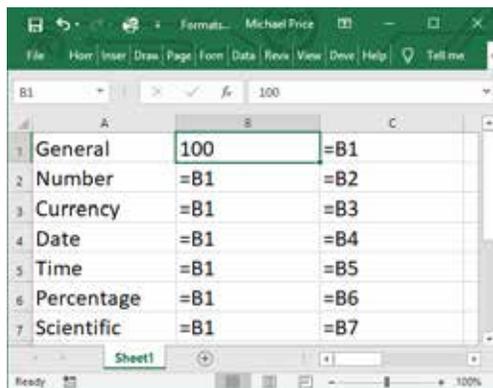
Cells C1 to C7 have no numeric format applied, so take up the General format, with the value of the cell that is referenced.

Cells C1 to C7 are assigned the contents of cells B1 to B7 respectively, and in each case the value of 100 is applied, whatever the display format may be.

Whenever a cell is referenced, it is the intrinsic value of the cell that will be made use of.

Values

You can use the **TYPE** function to check the contents of cells. This can identify five possibilities:

- **1** **Number**
- **2** **Text**
- **4** **Logical (True or False)**
- **16** **Error notification**
- **64** **Array**

For example:

Hot tip

The array identified in cell C5 is actually incorporated as a literal value in the TYPE statement.

Cells such as B4 in the above spreadsheet, or C7 in the first example on page 9, are **formulas**, identified by the initial = (equals sign).

Neither the **CELL** function nor the **TYPE** function will identify a formula as such, but will merely reflect the actual value that the formula produces.

Here are some example formulas:

Hot tip

These formulas contain references to a cell/cells (or they could contain literal values), and the values are processed by the operators that are included in the formula.

Here **CELL** identifies value and label contents, while **TYPE** identifies number, text, logical and error contents. If the results of a formula change, the type identified will change to match.

Formulas

Formulas in Excel can be very simple or very complex, but they all have the same basic features:

- **An initial e sign**
  (Tells Excel that a formula follows.)
- **One or more operands**
  (Values or cell references.)
- **One or more operators**
  (Symbols indicating how operands are treated.)

The Annual Budget spreadsheet includes some typical formulas:

1 Display the cell contents to see the actual formulas

Cells C3 to E3 replicate the adjacent cell. Cells B4 to E4 are percentages of cells B3 to E3. Cells F3 to F5 contain the combined values of the adjacent four cells. Cells B8 to E8 contain the combined values of the five cells above, calculated using the **SUM** function rather than just adding the specific cells.

Functions are predefined formulas, designed to carry out tasks that are frequently required, and to assist in the provision of the necessary data. In the following chapters, we explore the categories of functions and review examples of their use.

Operators

Operators used in Excel formulas fall into four groups:

- **Arithmetic**
- **Comparison**
- **Text**
- **Reference**

The operators available, their descriptions and examples of usage:

Each of the **Comparison** operators gives a **Logical** result, which can be either TRUE or FALSE.

The **Reference** operators allow you to select cells from one or two ranges. These cells can then be processed by other operators or functions – for example, to calculate the totals of all the selected cells. **Intersection** selects the cells that are common to two ranges – for example, the overlap. **Union** selects all the cells from both ranges.

Here is the **Intersection** of two ranges:

This shows the **Union** of two ranges:

Order of Calculation

If there are several operands and operators in a formula, the sequence in which the calculations are performed can be crucial. For example, the formula 4+8^2 could be evaluated from left to right, as 12^2, giving 144. Alternatively, the exponential could be computed first, as 4+64, giving 68.

To avoid any ambiguity, Excel uses a predefined sequence. This operator precedence is as follows:
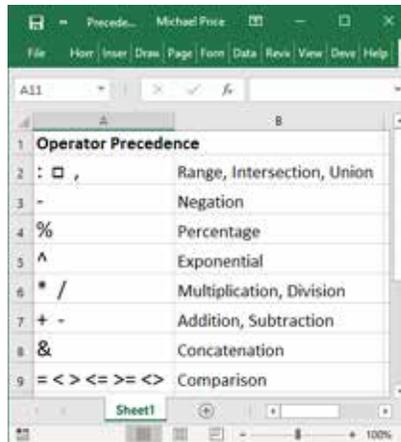
Operators such as ***** and **/** that are at the same level could be evaluated in any order. However, Excel chooses to evaluate them from left to right.

You can use parentheses to control the computation. Expressions within the innermost set of parentheses will be calculated first, then Excel works outwards.

To illustrate the effects of parentheses, the same formula is shown with various combinations of parentheses:
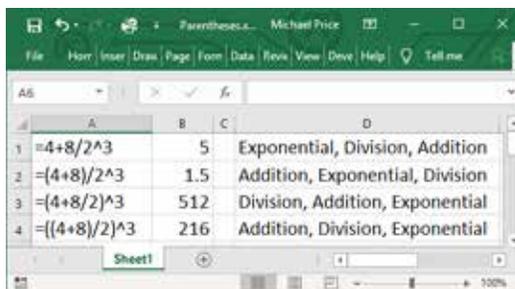
This sequence is known as **PEDMAS** (parentheses, exponential, division, multiplication, addition, subtraction). In Europe it is known as **BODMAS** (brackets, order, division, multiplication, addition, subtraction).

You can add parentheses and spaces to formulas, even if they are not strictly necessary, to make them easier to understand.

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The **Negation** operation is treated differently in Excel. Arithmetically the formula **-4^2** is **-16**. However, in Excel, **Negation** is applied before **Exponential** so the formula becomes **(-4)^2**, which is **16**.

Creating Formulas

You can use a combination of typing and selecting to create formulas using the various operators.

To add a formula to the example Expenses spreadsheet, to calculate the full cost of an item:

1 Double-click cell C3 to select that cell for editing

2 Type = and then click the cell B3 (or simply type B3)

3 Type *(1+ and then select or type B7 (the Taxrate)

Since Taxrate is a singular value, you'll want to make this an absolute reference, so that you can easily move or copy formulas that use this value.

4 Highlight the cell reference C7 and press F4 once to switch to absolute addressing

5 Type the closing parenthesis and press **Enter** to complete the formula

You can copy this formula to calculate the full cost of other items, using the fill handle.

1 Select C3, the cell with the formula, and click the fill handle on the lower right-hand corner

2 Drag down to replicate the formula in the next two cells, C4 and C5, then release the mouse

3 Select cell C6 and enter the formula =C3+C4+C5 typing or selecting the required cells, as preferred

4 Press **Enter** to complete the formula

You can also **Copy** the cell with the formula, then select the target cells and use **Paste** to replicate the formula.

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Since the Taxrate is an absolute reference, it will be replicated unchanged, while the other cell reference will be incremented.

Named References

When you have absolute references in your formulas, you can name them to make their purposes clearer.

To create a name for a particular cell:

1 Select the cell you want to name – B7, for example

2 Click the **Name** box, on the left of the Formula bar, then type the name – for example, **Taxrate**, then press **Enter**

3 Click the **Formulas** tab and select **Name Manager** in the **Defined Names** group to view all the names in the workbook
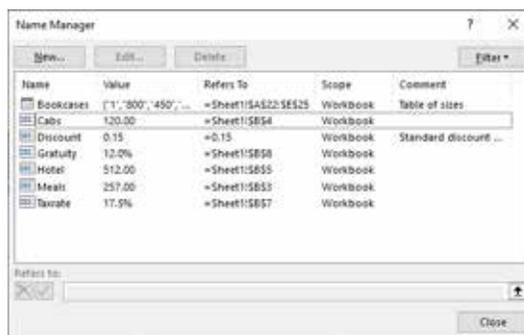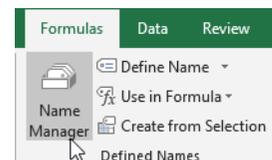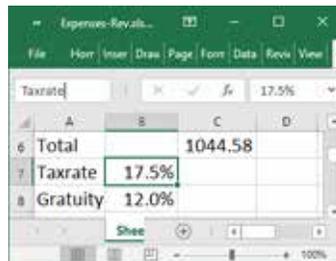
Names create absolute references to cells or ranges of cells. They can be used in formulas and, when these formulas are copied, the references will not be changed.

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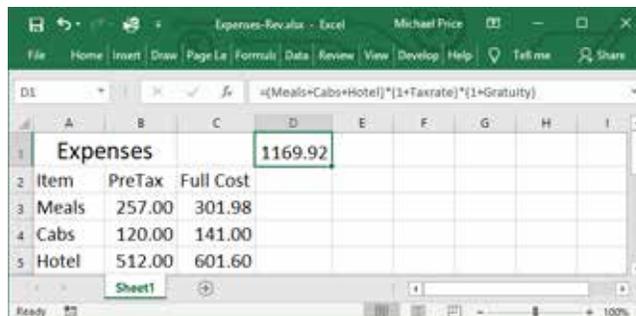
Named Constants

You can name a constant value directly, without having to allocate it to a specific cell. For example, if your formulas require a constant **Discount** rate, you can assign a name and a value as follows:

1 Select **Define Name** from the **Defined Names** group on the **Formulas** tab

2 The **New Name** dialog box is displayed

3 Select the **Name** box and type the constant name – e.g. **Discount**

4 Set the **Scope** – Workbook or Sheet – and add a description in the **Comment** box, if desired

5 Select the **Refers to** box and replace the cell reference with the required value (e.g. =0.15) and click **OK**
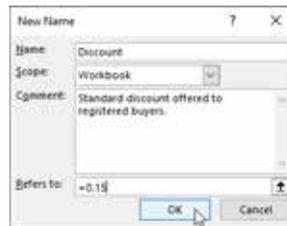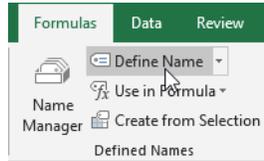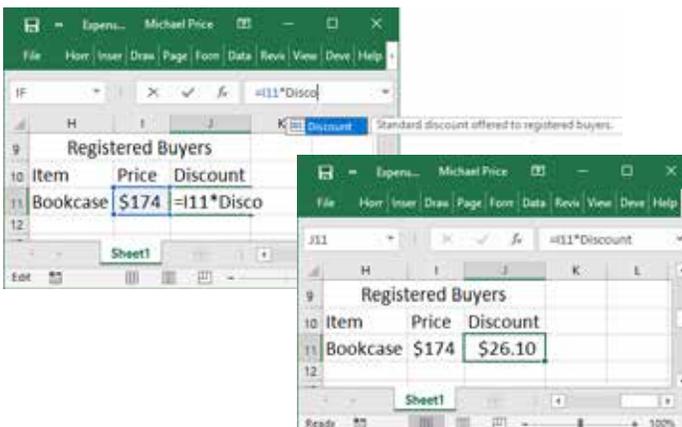
You can now use the defined name in your formulas. Note that the full name and description will be displayed as you start typing the defined constant name. Double-click to enter the name.

Formula Assistance

Excel provides assistance as you enter formulas, to make them easier to construct and to help you check that you have chosen the required values and operations.

1 When you type a defined name, Excel outlines the associated cell or range of cells

Hot tip

Here we calculate a numeric progression and the total and average of its terms. F, D and N are defined names.
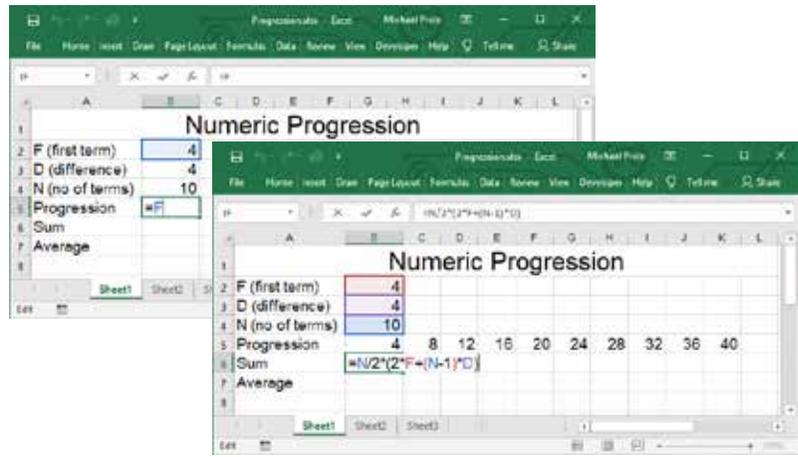
2 With nested calculations, Excel colors matching pairs of parentheses to clarify the operations

Don't forget

Coloring matching pairs of parentheses makes it easier to check the calculation and spot errors such as superfluous parentheses.
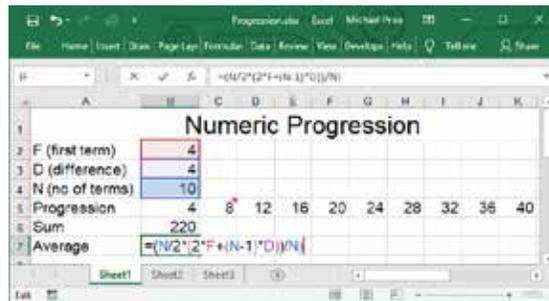
=(N/2*(2*F+(N-1)*D))/N)

3 If you do make a mistake, such as entering an extra parenthesis as shown above, Excel will detect the error and may offer a correction

Adding Comments

Add notes to a cell – for example, to explain how a particular formula operates. To add such a comment:
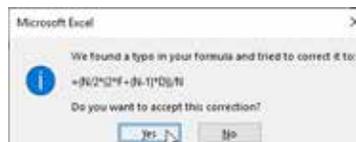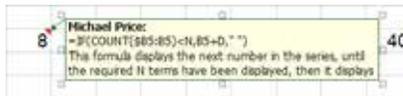
**1** Select the cell where the comment is meant to display

2 Click the **Review** tab and select **New Comment** from the **Comments** group

3 Your username is shown. Delete this if desired, then add your comments, and format the text if you wish

4 Select any other cell to save and close the comment

5 The red flash indicates the presence of a comment, which is displayed when you move the mouse over that cell
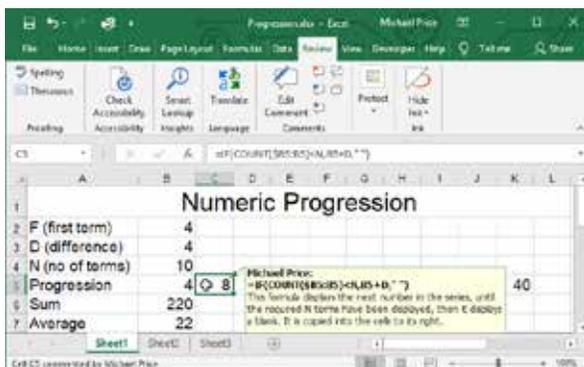
When you have comments in your worksheet, you can print them as displayed, or print all comments at the end of the sheet.

When you have created a comment, the **New Comment** button is replaced by the **Edit Comment** button. There's also a **Delete** button, **Previous** and **Next** to view other comments, **Show/Hide Comment** and **Show All Comments**.
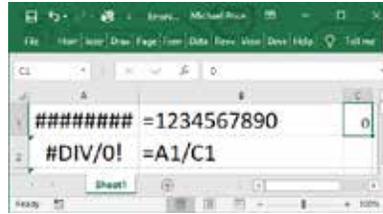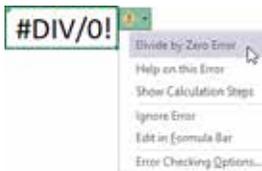
Error Values

If Excel detects a problem for which it is unable to offer a correction, it will place an error value in the cell. Here are some of the error values you may encounter:

1 When a number is too long to fit into a cell, the **Overflow** error is shown. Resolve by widening the cell or choosing a smaller number format
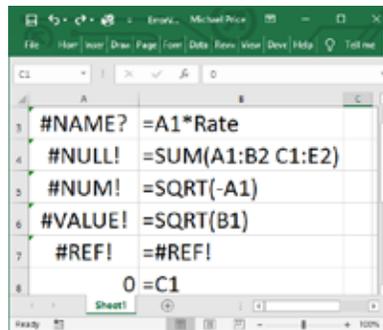

2 When the formula contains division by a value of zero or by an empty cell, you get a **Divide by Zero** error

3 A **NAME** error implies reference to a deleted name, or to a name that has not been defined

4 A **NULL** error results from referencing the intersection or two ranges that do not overlap

5 You'll get a **NUM** error with invalid arguments, such as a negative number with the square root function, or a **VALUE** error with an argument of the wrong data type

6 An invalid reference gives a **REF** error, such as when you copy a formula and get an invalid cell reference

Hot tip

When the error value shows a green flash, select the cell and click the Information icon for more details and options for handling the error.

Beware

If the formula has a reference to C1 and you copy the formula upwards, the relative reference changes to C0, which is an invalid cell reference.