

Section 6

Functions

By the end of this Section you should be able to:

- Use Logical Functions
- Use Date and Time Functions
- Use Lookup Functions
- Use Maths and Financial Functions
- Use Concatenate
- Nest Functions

Exercise 41 - Functions

Guidelines:

Functions are specialised preset formulas that make calculations easier. There are over 200 different functions available, grouped under various categories. Some examples include:

Statistical	COUNT, COUNTA, COUNTIF
Financial	NPV, FV, PMT, RATE, IRR
Logical	IF, OR, AND, TRUE, FALSE
Math & Trig	SUMIF, ROUND
Text	CONCATENATE, LOWER, PROPER, UPPER
Date & Time	TODAY, DAY, MONTH, YEAR, DATE, NOW, TIME
Database	DSUM, DMIN, DMAX, DCOUNT
Lookup & Reference	HLOOKUP, VLOOKUP

Statistical functions deal with analysing numerical data, from simple counting and averaging to calculating complex distribution parameters.

Financial functions deal mainly with calculations involving depreciation, loan repayments and investments over extended time scales.

Logical functions deal with the testing and setting of conditions involving TRUE or FALSE values.

Math & Trig functions deal with processing individual numerical data, from simple rounding to complex trigonometric calculations.

Text functions deal with manipulating text strings.

Date and Time functions deal with the processing and reformatting of all data relating to dates and times.

Database functions deal specifically with data held in a list or database.

Lookup & Reference functions deal mainly with retrieving data from tables, ranges or external sources.

A formula can consist of a single function, (remember the = sign), and functions can be used within other functions (nested functions) to build more complex formula.

Choosing a function to use in a formula can be a difficult task. If you are not familiar with the various functions you will have to look through the list of available functions to see if there is one to match your requirements. Hopefully you will know what category of function is needed, Statistical or Lookup for example, and you can narrow down the search by only searching the required category. Guides like this one, or on line help systems may provide some guidance, but inevitably some trial and error will be involved.

Exercise 42 - Logical Functions

Guidelines:

The logical function **IF** tests the contents of a cell and, if the logical test is met (TRUE condition), performs one action; if not (FALSE condition), it performs another.

=IF(Logical_test,Value_if_true,Value_if_false)

For instance, if the value in cell **A1** is greater than 10 then multiply it by 3, if not, multiply it by 2. This is expressed as: **=IF(A1>10,A1*3,A1*2)**

The **IF** function is sometimes described as **IF THEN ELSE**. **IF** the condition is true **THEN** do this **ELSE** do that.

AND and **OR** are logical functions that can be either **TRUE** or **FALSE**. **AND** tests 2 or more conditions and if every one is satisfied returns a value of **TRUE**, otherwise it returns a value of **FALSE**. So

=AND(A1>10,B1>10,C1>10)

is only **TRUE** if **A1** is greater than 10 and **B1** is greater than 10 and **C1** is greater than 10.


OR tests 2 or more conditions and if any one is satisfied returns a value of **TRUE**, otherwise it returns a value of **FALSE**. So

=OR(A1>10,B1>10,C1>10)

is **TRUE** if **A1** is greater than 10 or **B1** is greater than 10 or **C1** is greater than 10.

As the functions **AND** and **OR** return **TRUE** or **FALSE** values, they are often used in conjunction with **IF** functions in order to return a value for the logical test based on multiple conditions.

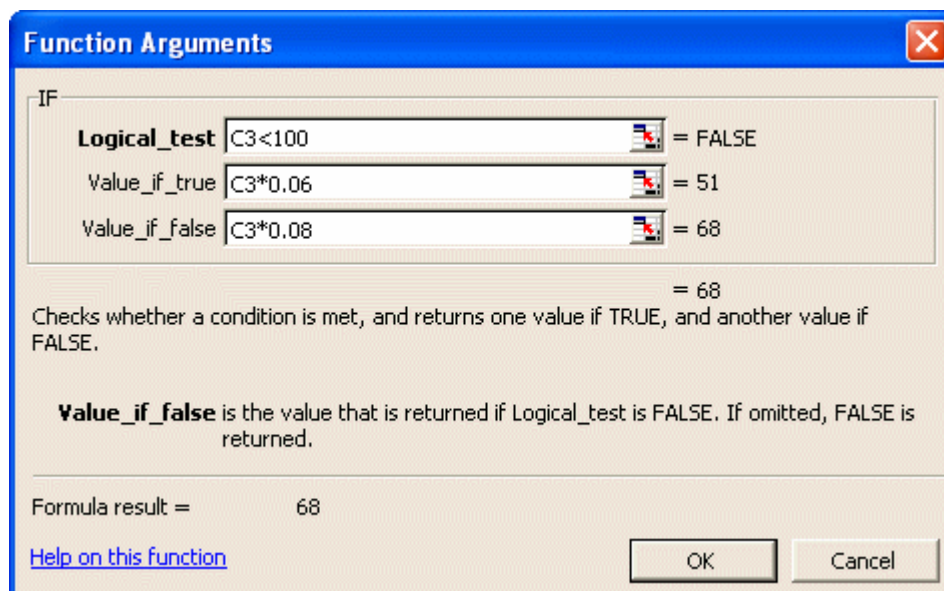
Actions:

1. On a blank worksheet, enter the label **Interest Calculation** in **B1**.
2. Enter the label **Balance** in cell **B3** and **Interest** in **B4**.
3. Enter any number in **C3** for your bank balance.
4. The interest on your money depends on whether the balance is over or under £100. Click in cell **C4** and then click the **Insert Function** button,  on the **Formula Bar**.

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Exercise 42 - Continued

5. Select **Logical** from the **Or select a category** box and then **IF** from the **Select a function** list.
6. Click **OK** and add the following parts of the test.



7. Click **OK** to complete the function. The function looks at the contents of cell **C3** and if less than **100**, calculates the interest at **6%** otherwise it calculates it at **8%**.
8. The result of the function, the interest, depends on the balance. In cell **C3** enter **100**. The interest is **£8**, the higher rate. Enter **50** and the interest is **£3**. Experiment, change the balance and see the interest change.
9. Enter the column of numbers **27, 8, 16, 35** in cells **D5** to **D8**. In cell **F5** enter the logical function **=AND(D5>10,D5<20)** by keying or using the paste function key. This will return the value **TRUE** if both conditions (**>10** and **<20**) are met and **FALSE** if they are not.
10. Copy the function from **F5** to the range **F6** to **F8**. Only one cell value (**16**) meets both conditions.
11. In cell **H5** enter the logical function **=OR(D5<10,D5>20)** by keying or using the paste function key. This will return the value **TRUE** if either condition (**<10** and **>20**) is met and **FALSE** if not.
12. Copy the function from **H5** to the range **H6** to **H8**. Only one cell value (**16**) does not meet either condition.
13. Close the workbook without saving.

Exercise 43 - Date and Time Functions

Guidelines:

Dates and times are stored as numbers of days since 00:00 on 1st Jan 1900. Calculations using dates and times are carried out using the numbers which represent the dates and times. There are two key presses which automatically insert the current date and time.

<Ctrl ;> Inserts the current date as text.

<Ctrl Shift ;> Inserts the current time as text.

There are also several functions for use purely with dates and times.

DATE Returns the number for a particular day, e.g. DATE(92,4,13) returns 33707, the number of days from 1st Jan 1900 to 13th Apr. 1992.

DAY, MONTH, YEAR Converts a date to a number representing the day, month, or year, e.g. DAY("23/11/67") would be 23.

NOW Used as NOW(). Returns the current date and time as a number, and is updated as the worksheet is calculated.

DATEVALUE Converts the date as text to a number, e.g. DATEVALUE("21-Sept-49") returns 18162.

TODAY Used as TODAY(). Returns the current date as a number and is updated as the worksheet is calculated.

WEEKDAY Converts a number to an integer representing the day of the week from 1 (Sunday) to 7 (Saturday), e.g. WEEKDAY("21-Sept-49") returns 4, Wednesday.

TIME Used as TIME(hour,minute,second). Returns a value in the range 0 to 0.99999999, representing a fraction of a day, e.g. TIME(16,48,10) returns 0.700115741.

TIMEVALUE Returns a number as a fraction of the day, e.g. TIMEVALUE("22nd-Aug-67 6:35 am") returns .274305556.

HOUR, MINUTE, SECOND Converts a time into hours, minutes, or seconds, e.g. HOUR("6:35pm") returns 18.

Actions:

1. Open a new workbook. This exercise shows some of the above functions in action.
2. In **B2**, enter the label **Time as number**. In **D2**, enter **Time as text**.
3. In **B4**, enter **=NOW()** and format it to display as **hh:mm**. Select **Format | Cells, Number** tab, **Time** category and **13:30:55** format.

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Exercise 43 - Continued

4. In **D4**, press **<Ctrl Shift ;>** to enter the current time.
5. In **B8**, enter the function **=TIME(8,30,0)** and custom format to display as **hh:mm**.
6. In **B12**, enter **=B4-B8** to calculate an elapsed time and format to display as **hh:mm**.
7. The **Time as number** and **Time as text** should now appear as different times. This is because the function **NOW()** is updated as the worksheet is calculated, while using **<Ctrl Shift ;>** puts text in the sheet, which is not updated.
8. In **F2**, enter **=TODAY()**. Widen the column if necessary.
9. In **F5**, enter **=DATE(** then your birthday as numbers in the form **yy,mm,dd** followed by **)**.
10. In **F8**, enter **=F2-F5**. Format the cell as a number with no decimal places. This shows your age in days (widen the column if you are very old!!).
11. In **H5**, enter **=WEEKDAY(F5)**. This gives a number corresponding to the day of the week on which you were born (Sunday = 1, Saturday = 7).
12. In **J5** enter **=DAY(F5)** to extract the day part of your birth date.
13. In **J6** enter **=MONTH(F5)** to extract the month part of your birth date.
14. In **J7** enter **=YEAR(F5)** to extract the year part of your birth date.
15. Close the workbook without saving.

Exercise 44 - Lookup and Reference Functions

Guidelines:

The **Lookup** functions are used to look up relevant data from a table, to use in a calculation. There are two functions, **HLOOKUP**, which searches a horizontal table and **VLOOKUP**, which searches a vertical table. A **Lookup** table consists of a selection of bands, or intervals, within which a given value can be found.

HYPERLINK is a **Lookup and Reference** function that is used to create a shortcut or jump to open another document, e.g.

=HYPERLINK("C:\My Documents\Kitchen Finance.xls","Click to open Finance")


would display **Click to open Finance** in the cell, blue and underlined. Clicking on the cell would close the current workbook and open the **Kitchen Finance** workbook.

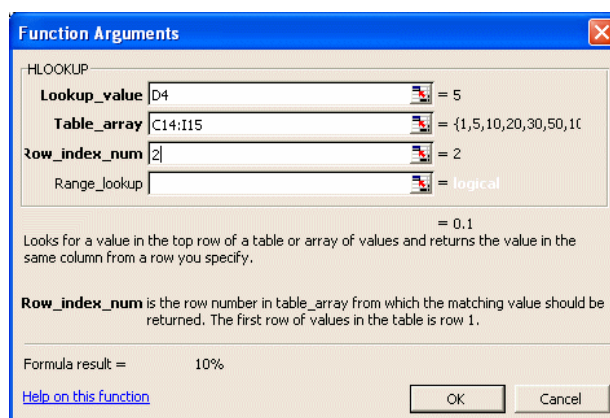
CHOOSE is a **Lookup and Reference** function that selects from a range of values or references, e.g.

=CHOOSE(A8,"Jan","Feb","Mar","Apr")

would display **Feb** if cell **A8** contained **2**.

Actions:

1. Open the workbook **Discount**. The worksheet consists of a discount calculation at the top and two lookup tables at the bottom, one horizontal and one vertical, containing the same data. The discount available depends directly on the number of items bought.
2. To use the **HLOOKUP** function, click in cell **D8**, click the **Insert Function** button, . Select the **Lookup & Reference** category and the function **HLOOKUP**. Click **OK**.
3. The **Lookup_value** is cell **D4** (number bought). The **Table_array** is **C14:I15** (the table without the labels) and the **Row_index_num** is **2** (to return the value from the 2nd row of the table).




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Exercise 44 - Continued

*Note: Setting the **Range_lookup** to **FALSE** causes the function to return a value only if there is an exact match between the **Lookup_value** and the table entry.*

- Click **OK**. The value returned is **10%**, corresponding to selling between 5 and 9 items.

	A	B	C	D	E
1	Lookup Tables				
2					
3		Price		£69.95	
4		Number Bought		5	
5					
6		<u>Total Price</u>		<u>£349.75</u>	
7					
8		Discount %		10%	
9		<u>Discount</u>		<u>£34.98</u>	
10		<u>Discount Price</u>		<u>£314.78</u>	
11					

- Change the number bought in **D4** to **23**. The **Discount %** changes, and so does the **Discount Price**.
- Delete the contents of cell **D8**.
- To use the **VLOOKUP** function, click in cell **D8**.
- Click the **Insert Function** button, . Select the **Lookup & Reference** category and the function name **VLOOKUP** (this function is similar to **HLOOKUP** except the base data is stored in columns).
- Click **OK**.
- The **Lookup_value** is cell **D4** (number bought). The **Table_array** is **B19:C25** (the table without the labels) and the **Col_index_num** is **2** (to return the value from the 2nd column of the table). Similar to the dialog box for **HLOOKUP**.
- Click **OK** to complete the function.
- Change the number bought in **D4** to **52**. The **Discount %** changes to **45%** the **Discount Price** is **£2000.57**.
- Close the workbook without saving.



Exercise 45 - Maths and Statistical Functions

Guidelines:

The **COUNT** function counts the numeric items in a range of cells. **COUNTA** is used to count all cells in a range. **COUNTIF** counts numeric items that match a set condition.

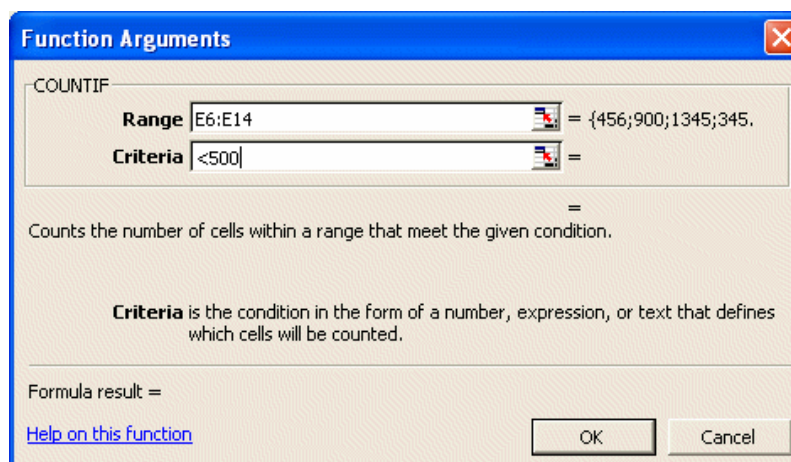
SUMIF only sums values within a range that match a set condition, e.g. to sum the outstanding amounts of clients that owe more than £100. **ROUND** can be used to round a numeric value to any number of figures.



Actions:

1. Open the workbook **Invoices**.
2. Select cell **A16** and click the **Insert Function** button, .
3. Select **Statistical** from **Or select a category** and **COUNT** from **Select a function**.
4. Click **OK** to display the **COUNT** box.
5. In the **Value1** box, select or enter the range **A6:A14**.
6. Click **OK** to display the count of invoices, (9). This works because column **A** contains only numeric values.
7. Copy the function in **A16** to **D16**. The count will be zero because column **D** is not numeric.
8. Select **D16** and edit the contents, changing **COUNT** to **COUNTA**. The total should now be correctly shown as 9.
9. Delete the contents of cell **D16** and enter the label **Invoices under £500**.
10. Select cell **E16** and click the **Insert Function** button, .
11. Select **Statistical** from **Or select a category** and **COUNTIF** from **Select a function**.
12. Click **OK** to display the **COUNTIF** box.
13. Select the **Range** as **E6:E14**.
14. Set the criteria in the **Criteria** box as **<500**.

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Exercise 45 - Continued



15. Click **OK**. Check the **Formula Bar** for the formula (the speech marks are added automatically). The cells that match the condition are counted. These cells can also be summed using **SUMIF**.
 16. In cell **D17**, enter the label **Small invoices total**.
 17. In cell **E17** click the **Insert Function** button, . Select the **Math & Trig** category and the function **SUMIF**.
 18. Click **OK** to display the **SUMIF** box.
 19. Select the **Range** as **E6:E14**. Set the criteria in the **Criteria** box as **<500**.
 20. Click **OK** to paste the function. The invoices that are under £500 are summed. The formula is similar to **COUNTIF** except that the cells are added.
 21. To show the invoice totals to the nearest pound, select cell **H6**. Click the **Insert Function** button, . Select **Math & Trig** category and the function **ROUND**.
 22. Click **OK** to display the **ROUND** box.
 23. Select the **Number** as **G6**. Set the number of digits in the **Num_digits** box as **0**.
 24. Click **OK** to paste the function. The invoice total is shown to the nearest pound.
 25. Copy the function in **H6** to fill the range **H7** to **H14**.
- Note: Even though the values in column H have been rounded to the nearest pound, they are still displayed in the original number format.*
26. Close the workbook without saving.

Exercise 46 - Text Functions

Guidelines:

The ampersand symbol, **&**, or the **CONCATENATE** function can be used to connect the contents of two or more cells. Other text manipulation functions are used to change text entries into the required form. **LOWER(string)** changes the entry into lower case. **UPPER(string)** changes the entry into upper case (capitals) and **PROPER(string)** changes the entry into lower case with capital first letters.

These functions are used when data is required to be joined or required in a different format to that which has been entered or imported.

Actions:

1. Open the workbook **Strings**.
2. In **B10**, enter the formula **=B4&C4&D4**. The words are joined, but with no spaces.
3. In **B11**, enter the function **=B4&" "&C4&" "&D4**. Each set of speech marks are around one space. This adds the spaces between the text.
4. The function **CONCATENATE** can be used to achieve the same result. In **B12**, enter the formula **=CONCATENATE(B4," ",C4," ",D4)** to achieve exactly the same effect as step 3.
5. The **Ref No.** is made up of the initials of the customer added to the invoice number. In **H4** enter the function **=LEFT(C4,1)&LEFT(D4,1)&E4**. This gives an individual reference number.
6. Copy the formula in **H4** down to **H5** and **H6**.
7. Click the **Text** sheet tab and in cell **B2**, type (in lower case) **upper**, in **C2** type **lower** and in **D2** type **proper**.
8. In **B4** enter the function **=UPPER(B2)**. The word **UPPER** will appear in capitals, i.e. upper case.
9. In **C4** enter the function **=LOWER(C2)**. The word **lower** stays the same.
10. In **D4** enter the function **=PROPER(D2)**. This produces the word **Proper**.
11. Enter a phrase (a few words) into the cell **B2**, copy the cell to the range **C2:D2**. Use the three functions **UPPER**, **LOWER** and **PROPER** in the cells **B4**, **C4** and **D4**. Examine the results. Change the text in cell **B2**.
12. Close the workbook without saving.

Exercise 47 - Nested Functions

Guidelines:

When a complex formula is required in a single cell it is often necessary to use a **Nested Function**. This is when the result of one function becomes one of the values in another function. An example of nested text functions is **=UPPER(LEFT(B2,3))**. The **Left** function returns the left three characters in the cell **B2**, then the **Upper** function converts these characters to upper case.

A common use for nested functions is in the **IF** function, where the logical test, is replaced by a logical function. For example the simple function,


=IF(A1>10,"Good", "Bad")

returns a value of **Good** if the value in **A1** is greater than **10**. If the condition became more complex, e.g. greater than 10 and less than 20, it would have to be replaced by a nested **AND** function

=IF(AND(A1>10,A1<20),"Good", "Bad")

It is vital that the nested function returns a value of the same type as required by the first function or an error will result. In the above examples, **LEFT** returns a text field, which is required for the **UPPER** function; **AND** returns a logical value (TRUE or FALSE) which is required as the first value for the **IF** function.

Actions:

1. Open the workbook **Employees**. It is decided to pay a **£15** bonus to all employees over **40** who have had less than **2** days absence this year.
2. Enter the label **Bonus** in cell **G1**.
3. Select cell **G2** and click the **Insert Function** button, .
4. Select the **Logical** category and the **IF** function.
5. Click **OK** to display the **IF** box.
6. In the **Logical_test** field enter the function **AND(E2>=40,F2<2)**. This function represents the required condition. It is nested inside the **IF** function.
7. Enter **15** in the **Value_if_true** field and **0** in the **Value_if_false**.
8. Click **OK** to enter the function.
9. Copy the nested function from **G2** to the range **G3** to **G20** to see who qualifies for the bonus.
10. Close the workbook without saving.

Exercise 48 - Revision: Functions

Assessment

Use at least one formula that performs a multi-stage calculation. Concatenate text strings and cell references.

1. Open the workbook **Kitchen**.
2. On the **Order Details** sheet, a formula is to be placed in cell **F42** that will represent an amount of discount of **10%** on orders **£5,000** or over. Enter **=IF(F41>=5000,F41*0.1,"None")** as the formula.
3. Right align cell **F42**.
4. In cell **F43** calculate the **Grand Total**, the sub total minus the discount. This displays an error **#VALUE** when the discount is None.
5. To rectify this, redo the formula in cell **F43** to calculate the **Grand Total** without using cell **F42**, i.e. **=IF(F41>=5000,(F41-(F41*0.1)),F41)**. It would have been easier to replace **"None"** with **0** in cell **F42** (**objective 2c**).
6. In **E4** create the customer reference, using the **CONCATENATE** function to combine the customers initials from cells **C4** and **B4** and the postcode in cell **D4** (separate the initials from the postcode with a **/**, remembering to include speech marks around it) (**objective 2h**).
7. To save entering the current date for every customer, add the **NOW** function to cell **F5**.
8. To make the worksheet less cluttered the display of zeros can be suppressed. Select **Tools | Options** and on the **View** tab uncheck **Zero values**. Click **OK**. Zeros are now not displayed on the worksheet making it easier to use.

*Note: Completing this section of the guide has allowed the following elements of the **Evidence Checklist** to be completed. In your checklist, the ticks must be replaced by the page numbers of your portfolio where the relevant evidence is located. This task may have to be delayed until the portfolio is complete and page numbers have been applied.*

2	use formulae and functions in spreadsheets	Page Number	
2b	use at least one named range		<input type="checkbox"/>
2c	use at least one formula that performs a multi-stage calculation	✓	<input type="checkbox"/>
2d	use at least one nested function in a formula		<input type="checkbox"/>

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