Section 14 Functions

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

Use Date and Time Functions

Use Lookup Functions

Use Mathematical and Statistical Functions

Use Financial Functions

Use Text and Database Functions

Use Nested Functions

To gain an understanding of the above features, work through the **Driving Lessons** in this **Section**.

For each **Driving Lesson**, read the **Park and Read** instructions, without touching the keyboard, then work through the numbered steps of the **Manoeuvres** on the computer. Complete the **Revision Exercise(s)** at the end of the section to test your knowledge.

Driving Lesson 65 - Functions

Park and Read

Functions are specialised formulas that make calculations easier. They are grouped into categories, and some of the more common functions are listed here, grouped into the appropriate categories:

Statistical	COUNTIF, COUNTBLANK, RANK
Financial	NPV, FV, PV, PMT
Logical	IF, OR, AND, TRUE, FALSE
Math & Trig	SUMIF, ROUNDDOWN, ROUNDUP
Text	LEFT, RIGHT, MID, TRIM, CONCATENATE
Date & Time	TODAY, NOW, DAY, MONTH, YEAR
Database	DSUM, DMIN, DMAX, DCOUNT, DAVERAGE
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, usually numeric, held in a list or database.

Lookup & Reference functions deal mainly with data in tables or ranges, for example retrieving values or transposing vertical and horizontal ranges.

Functions, like formulas, are preceded by an = sign.

Functions can be used as values in calculations.

Functions can be used within other functions (nested functions).

Driving Lesson 66 - Date and Time Functions

Park and Read

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.

Driving Lesson 66 - Continued

Manoeuvres

1. Open a new workbook. This Driving Lesson 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:ss**. Select **Format | Cells**, **Number** tab, **Time** category and **13:30:55** format.
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.
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 a **)**.
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.

Driving Lesson 67 - Lookup Functions

Park and Read

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.

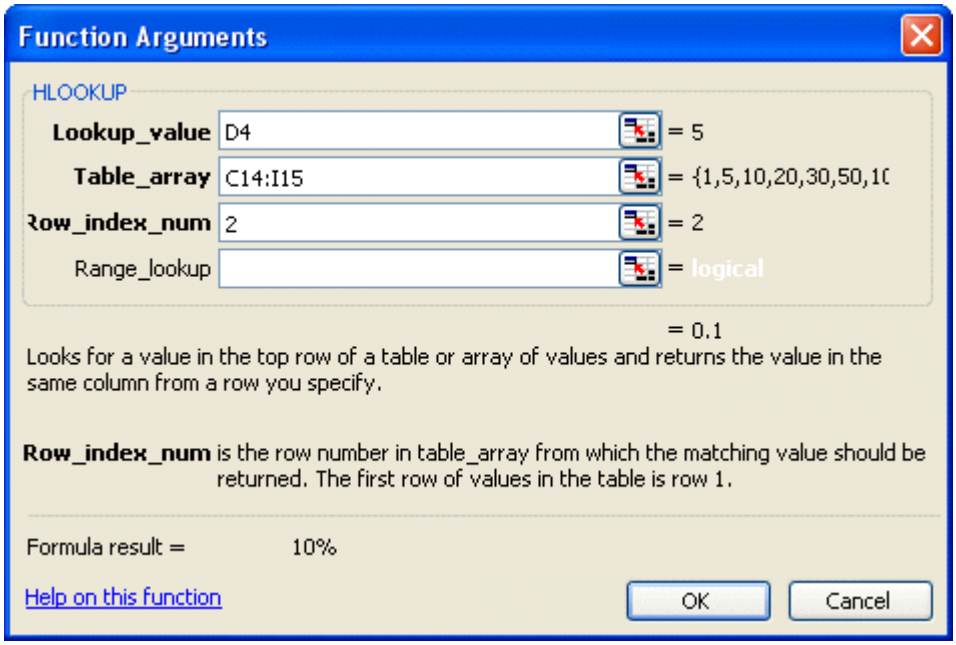
Manoeuvres

1. Open the workbook **Discount**. The worksheet consists of a discount calculation at the top and two lookup tables at the bottom, one a 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**.

3. Click the **Insert Function** button,  . Select the **Lookup & Reference** category and the function name **HLOOKUP** and then click **OK**.

4. 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).

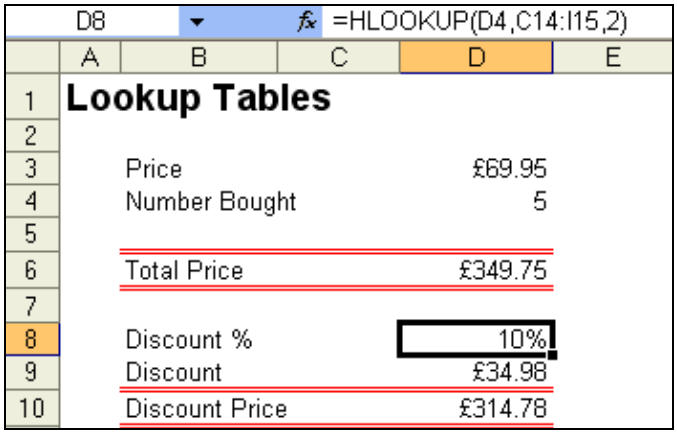


*Setting the **Range_lookup** to **FALSE** causes the function to return a value only if there is an exact match between the **Lookup_value** and the table entry.*

5. Click **OK**.

Driving Lesson 67 - Continued

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



7. Change the number bought in **D4** to **23**. The **Discount %** changes, and so does the **Discount Price**.

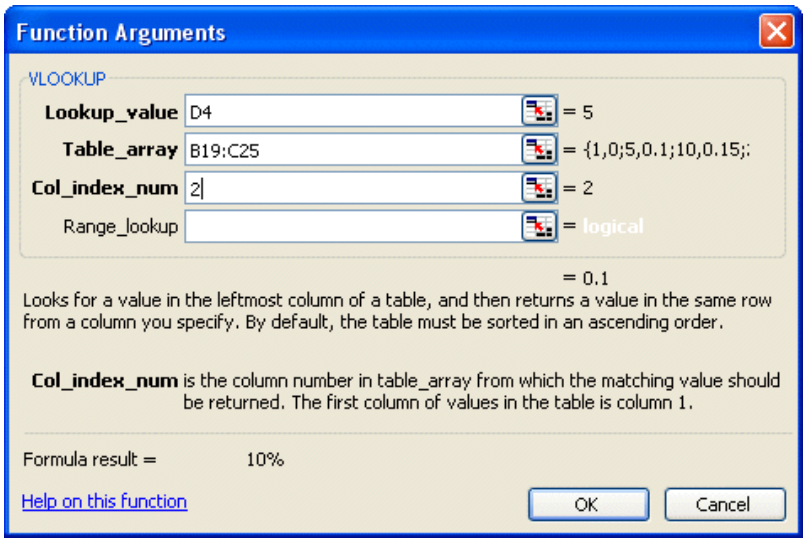
8. Delete the contents of cell **D8**.

9. To use the **VLOOKUP** function, click in cell **D8**.

10. 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).

11. Click **OK**.

12. 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).



13. Click **OK** to complete the function.

14. Change the number bought in **D4** to **52**. The **Discount %** changes to **45%** the **Discount Price** is **£2000.57**.

15. Close the workbook without saving.

Driving Lesson 68 - Mathematical Functions

Park and Read

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.

ROUNDUP and **ROUNDDOWN** can be used to round a numeric value to any number of figures either up or down.

Manoeuvres

1. Open the workbook **Invoices**.
2. In cell **D17**, enter the label **Small invoices total**.
3. Select cell **E17** and click the **Insert Function** button,  .

*An alternative to the **Insert Function** button is to use the **Insert | Function** menu command.*

4. Select the **Math & Trig** category and the function **SUMIF**. Click **OK** to display the **Function Arguments** box for **SUMIF**. Select the **Range** as **E6:E14** and enter the **Criteria** as <**500**. Click **OK**.
5. To show the invoice totals rounded down to the nearest pound, enter **Round Down** in **H5** then select cell **H6**. Click the **Insert Function** button,  . Select **Math & Trig** category and the function **ROUNDDOWN**.
6. Click **OK** to display the **Function Arguments** box for **ROUNDDOWN**.
7. Select the **Number** as **G6**. Set the number of digits in the **Num_digits** box as **0**. Click **OK** to insert the function. The invoice total is shown rounded down to the nearest pound.
8. Copy the function in **H6** to fill the range **H7** to **H14**.
9. The customer would benefit from rounding down. **ROUNDUP** raises the amount higher to the specified level, usually to the next pound. Enter **Round Up** in cell **I5** then select cell **I6**.
10. Select the **ROUNDUP** function. Select the **Number** as **G6** and set the number of digits in the **Num_digits** box as **0**. Click **OK** to insert the function. The invoice total is shown rounded up to the nearest pound
11. Copy the function in **I6** to fill the range **I7** to **I14**.
12. Experiment with **ROUNDUP** and **ROUNDDOWN** functions by using numbers other than 0 in the **Num_digits** box (try using 2,1,-1 and -2 to see the effects in the **Function Arguments** box).
13. Leave the workbook open.

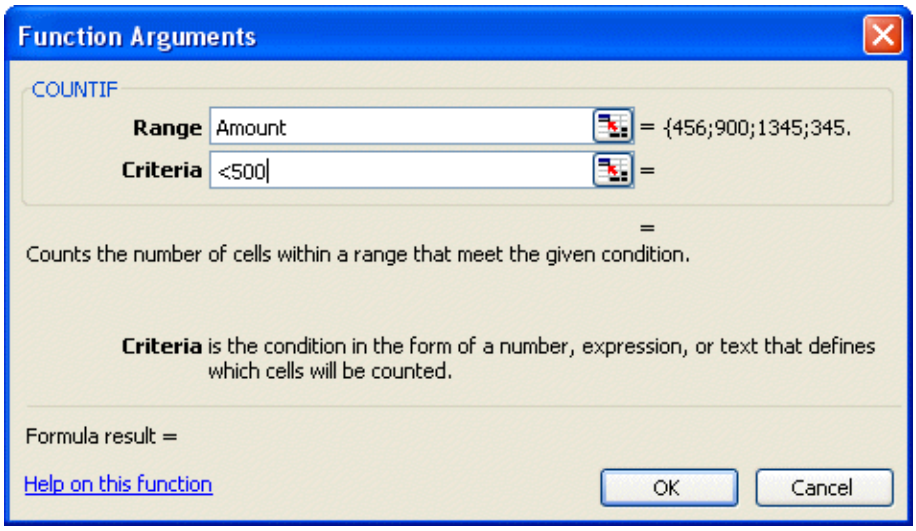
Driving Lesson 69 - Statistical Functions

Park and Read

COUNTIF counts numeric items that match a set condition. **COUNTBLANK** counts the number of blank cells in a range. **RANK** displays a number's position in a list.

Manoeuvres

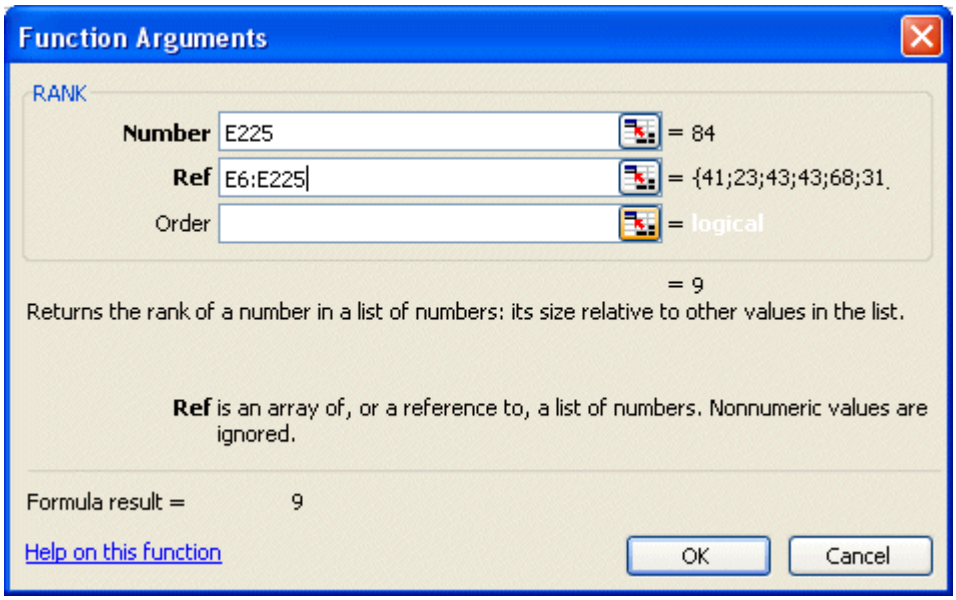
1. The workbook **Invoices** should still be open. If not, open it.
2. In cell **D16** enter the label **Invoices under £500**.
3. Select the range **E6:E14**. Select **Insert | Name | Define**.
4. **Amount** is suggested as the name for the range, click **Add** then **OK**. The range of amounts is now named **Amount** and can be used in the function.
5. Select cell **E16** and click the **Insert Function** button, .
6. Select the category **Statistical** and the function **COUNTIF**.
7. Click **OK** to display the **Function Arguments** box for **COUNTIF**.
8. In the **Range** box either type **Amount** or click and drag the range **E6:E14**. The range name is shown in the box.
9. Set the criteria in the **Criteria** box as **<500**.



10. Click **OK**. Check the **Formula Bar** for the formula (the speech marks are added automatically). The cells that match the condition are counted.
11. Close the workbook without saving.
12. Open the workbook **Survey**.

Driving Lesson 69 - Continued

13. The function **COUNTBLANK** can be used to calculate the number of people who have not replied to the survey. In cell **F227** enter **Not Replied**.
14. Click in cell **G227** and click the **Insert Function** button, fx.
15. Select the category **Statistical** and the function **COUNTBLANK**.
16. Click **OK** to display the **Function Arguments** box for **COUNTBLANK**.
17. Select the **Range** as **G6:G225**.
18. Click **OK**. The function counts the blank cells, i.e. the people who have not replied. The answer displayed is **145**.
19. The **RANK** function orders the values in a range and displays a number's position in the list, for example, the last person in the list, is he the oldest person surveyed? In cell **H225** enter **Ranked by age**.
20. Make sure that the label is left aligned.
21. Click in cell **J225** and click the **Insert Function** button, fx.
22. Select the category **Statistical** and the function **RANK**.
23. Click **OK** to display the **Function Arguments** box for **RANK**.
24. Select **E225** as the **Number** (the last person in the list) and select the **Ref** as **E6:E225** the range of all the ages.



25. Click **OK**. The function ranks the selected age and displays **9**. Therefore there are eight older people surveyed in the list.
26. Close the workbook without saving.

Driving Lesson 70 - Text Functions

Park and Read

The ampersand symbol, **&**, or the **CONCATENATE** function can be used to connect the contents of two or more cells that contain text. Other text manipulation functions are used to extract parts of text entries. **LEFT** extracts characters from the left, **RIGHT** extracts characters from the right, **MID** extracts characters from the middle (starting position and number of characters) and **TRIM**, used to tidy up data entry by removing space from an entry leaving only one space between words.

Manoeuvres

1. Open the workbook **Strings**.
2. On the **Strings** sheet, in **G4**, enter the formula **=A4&B4&C4**. The words are joined together, but with no spaces.
3. In **G5**, enter the function **=A4&" "&B4&" "&C4**. 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 **G6**, enter the formula **=CONCATENATE(A6," ",B6," ",C6)** to achieve exactly the same effect as step 3.
5. Copy **G6** up to **G5** and **G4**.
6. The **Ref No**. is made up of the initials of the customer added to the invoice number. In **F4** enter the function **=LEFT(B4,1)&LEFT(C4,1)&D4**. This gives an individual reference number.
7. Copy the formula in **F4** down to **F5** and **F6**.
8. The stock list in cell **A11**, **0543BW00521** is made up of a part number (first 4 characters), the initials of the person who checked it (the next 2 characters) and the amount in stock (the last 5 characters).
9. In cell **B11**, enter the formula to extract the first 4 characters, the part number **=LEFT(A11,4)**. Press <**Enter**>.
10. In cell **C11**, enter the formula to extract the initials of the person who checked the item **=MID(A11,5,2)**, this starts at the 5th character and extracts 2 characters. Press <**Enter**>.
11. In cell **D11**, enter the formula to extract the last 5 characters, number of items in stock **=RIGHT(A11,5)**. Press <**Enter**>.

Driving Lesson 70 - Continued

12. In cell **A15** is an example of a driving licence. In cell **B15** use the **MID** function to extract the date of birth. The day is characters **9** and **10**. The month is characters **7** and **8**. The year is character **6** and **11**.

13. The date of birth should be **29/05/36**. Copy the formula to cell **B16**. What is this date of birth?

14. Display the **Text** sheet. This shows a small list of names where spaces have been captured in error. To tidy the display the **TRIM** function can be used.

15. In cell **C4** enter the function **=TRIM(B4)**.

16. Copy the function from **C4** down the column to cell **C12**.

17. To see the effect of **TRIM** in greater detail, the range **B4:B12** has been copied to the starting cell to **B15**. Highlight the range **B15:B23** and select **Edit | Replace**.

18. In the **Find what** box, enter a space and in the **Replace with** box enter a hash (#).

19. Click **Replace All**, click **OK** and then close the dialog box. This shows where the spaces were.

20. Close the workbook without saving.

Check the answers at the back of the guide.

Driving Lesson 71 - Financial Functions

Park and Read

Three of the many financial functions deal with the repayment of loans. If **pv** is the present (original) value of the loan, **rate** is the interest rate per period, **nper** is the total number of payments and **pmt** is the repayment per period, the following functions can be used.

=PMT(rate,nper,pv)	Calculates repayments if **rate, nper** and **pv** are known.
=RATE(nper,pmt,pv)	Calculates the rate if **pmt, nper** and **pv** are known.
=PV(rate,nper,pmt,)	Calculates the loan value if **rate**, **pmt** and **nper** are known.

Similar functions deal with the results of investing or saving;

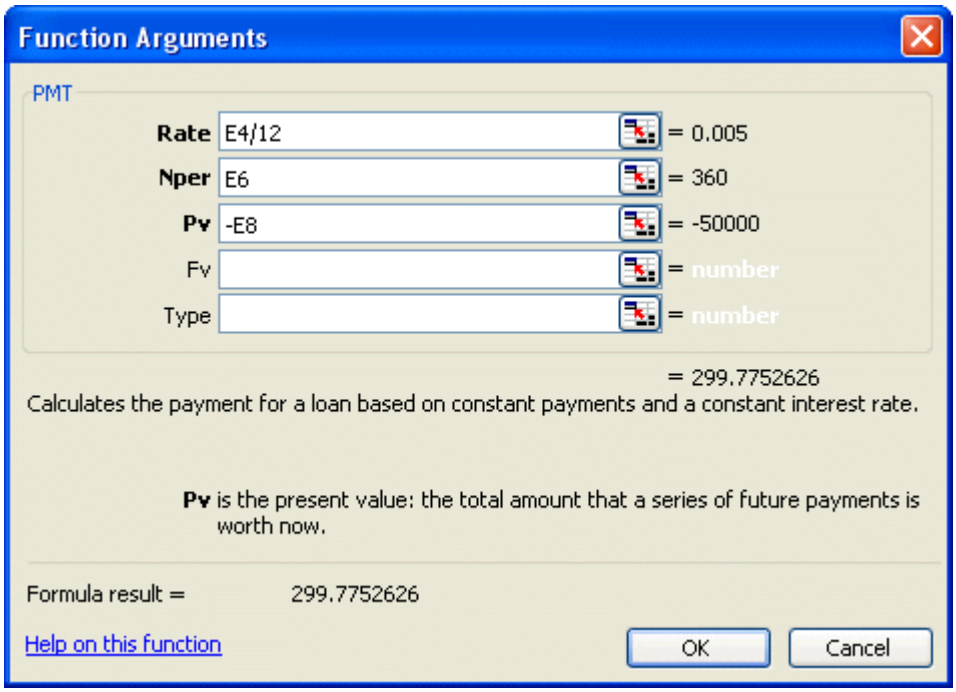
=FV(rate,nper,pmt)	Calculates the final value of saving an amount **pmt** for **nper** periods at **rate** percent interest.
=NPV(rate,value1,value2,..)	Calculates the net present value of an investment using a comparison discount rate of **rate** and a series of future income payments (positive values) and payments (negative values).

Manoeuvres

1. Open a new workbook in which a loan repayment is to be calculated.
2. In **C2** enter the label **LOAN ANALYSIS**.
3. In **C4** enter **Interest Rate**.
4. In **C6** enter **Term (months)**.
5. In **C8** enter **Loan Amount**.
6. In **E4** enter the interest rate as **6%**.
7. The **Term** is the length of the loan. Enter **360** into **E6** (30 years).
8. In **E8** enter the size of the loan, **£50000**.
9. In **C10**, enter the label **Monthly Repayment**.
10. In **C11**, click the **Insert Function** button,  . Select the **Financial** category and the payment function **PMT**. Click **OK**.

Driving Lesson 71 - Continued

11. Complete the dialog box as below:



12. The **Rate** is divided by 12 to obtain a monthly rate, and the **Amount** is entered as negative because the loan is an amount owed. Click **OK** to complete the function.

13. Change the interest rate to **8%**.

14. If the maximum affordable repayment is **£300**, the maximum loan value can be calculated using **PV**.

15. In **G4** enter **8%**, in **G6** enter **360** and in **G10** enter **300**.

16. In **G8** enter the function **=PV(G4/12,G6,-G10)** to see that the maximum amount that can be borrowed.

17. To see the result of investing the same amount of money under the same conditions, in **I8** enter the function **=FV(G4/12,G6,-G10)**.

18. Save this workbook as **Loan Analysis**.

19. Close the workbook.

Check the answers at the back of the guide.

Driving Lesson 72 - Database Functions

Park and Read

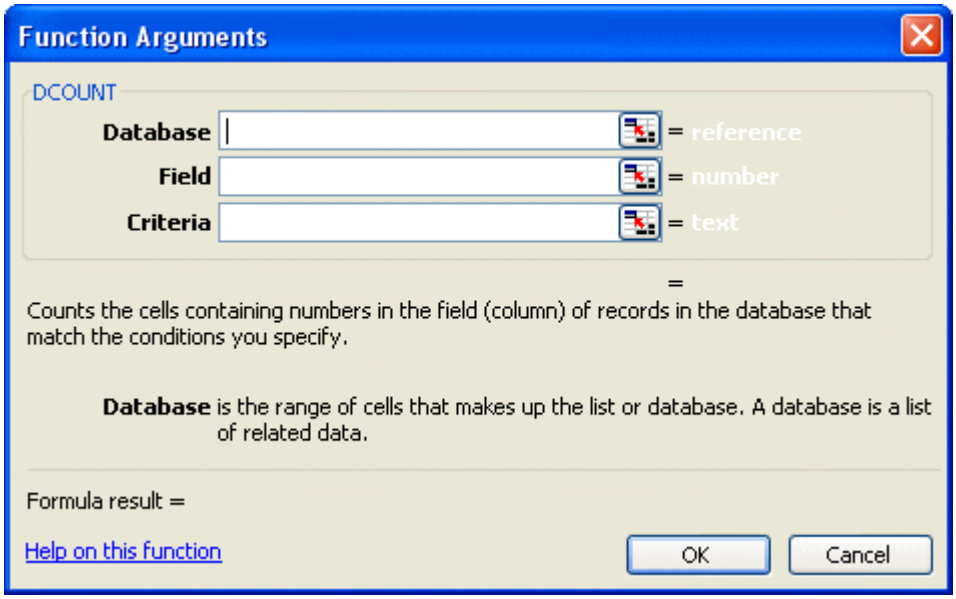
There are functions especially designed to be used with lists. The functions perform calculations on fields in a list, but only on those records which meet the selection conditions defined in the criteria range. For example in a list of sales by city, database functions can be used to obtain values for a specific city only, by selecting that city in the criteria range. The available functions are as follows.

Function	**Results**
DAVERAGE	Averages numbers
DCOUNT	Counts numbers
DCOUNTA	Counts nonblank cells
DGET	Extracts a single value
DMAX	Finds a maximum value
DMIN	Finds a minimum value
DPRODUCT	Multiplies numbers
DSTDEV	Calculates standard deviation of a sample
DSUM	Adds numbers
DVAR	Calculates variance of a sample

Manoeuvres

1. Open the workbook **Survey**.
2. To find information about people who have replied to the survey, copy the top line of the list, the titles, to row **2**. Rows **2** and **3** will be the area where the selection criteria for the functions will be set.
3. Enter **1** in **G3**, under **Reply**. (Only include records where **Reply** = '**1**')
4. In **I2** enter the label **Replies**, in **I4**, **Oldest**, in **I6**, **Youngest**, in **I8**, **Total** and in **I10**, **Average**.
5. Select the cell **J2** and select **Insert | Function**.
6. The **Insert Function** dialog box is displayed. Choose the category **Database** and the function **DCOUNT** from the list. Click on **OK**. The **DCOUNT** dialog box is then displayed.

Driving Lesson 72 - Continued



7. In **Database** enter **A5:G225,** in **field** click on **G5**.
8. In the **criteria** box, point or enter **A2:G3**.
9. Click **OK** to display the total number of replies.
10. Follow the same procedure to find the oldest person to reply. In **J4** enter = **DMAX(A5:G225,E5,A2:G3)**. Check the age field to confirm the answer.
11. In **J6** enter **=DMIN(A5:G225,E5,A2:G3)**. This displays the age of the youngest person to reply. Check the age field to confirm the answer.
12. In **J8** enter **=DSUM(A5:G225,E5,A2:G3)**. This displays the total age of all persons who have replied.
13. In **J10** enter **=DAVERAGE(A5:G225,E5,A2:G3)**. This displays the average age of all persons who have replied.
14. Close the workbook without saving.

Check the answers at the back of the guide

*Some of the answers in this Driving Lesson are rather vague as the worksheet contains the **Now** function to calculate ages from dates of birth. Everyone is getting older by the day, therefore the sum of their ages and the average age are increasing constantly.*

Driving Lesson 73 - Nested Functions

Park and Read

Individual functions can be combined with each other to form more complex functions. When one of the values within a function is itself a function, this is known as a **Nested Function**. An example of nested text functions is **=UPPER(LEFT(B2,3))**, which would return the upper case of the left three characters in the cell **B2**.

A common use for nested functions is in the **IF** function, where the logical test, e.g. **A1>10** within **=IF(A1>10,"Yes","No")** could be replaced by another function, e.g. **AND(A1>10,A1<20)** for greater control.

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.

Manoeuvres

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

*Check the **Answers** section at the end of the guide*

Driving Lesson 74 - Revision: Functions

This is not an ECDL test. Testing may only be carried out through certified ECDL test centres. This covers the features introduced in this section. Try not to refer to the preceding Driving Lessons while completing it.

1. Open the workbook **Employees**, insert two rows at the top of the sheet and copy the column headers to the new **Row 1**.
2. In **F24** use the **COUNTIF** function to calculate the number of staff over 40 years. Manually check the age column to confirm the answer.
3. In **F25** calculate the same value using **DCOUNT**. Use **rows 1** and **2** as the **Criteria** range.
4. In **F26** use **DAVERAGE** to find the average age of staff over 40.
5. In **F27** use **ROUND** to display the average age from **F26** to the nearest whole number.
6. Without altering the functions, find the **DCOUNT** and **DAVERAGE** values for staff over 30.
7. Create the lookup table and use **HLOOKUP** to calculate an attendance bonus (**Bonus 1**) in **Column G** based on; 0-2 days absence, £50; 3-5 days, £25, 6 or more days, £0 (w*hen copying a **HLOOKUP** function down a column, remember to use absolute addressing for the lookup table)*.

Absence	0	3	6
Bonus	£50	£25	£0

8. In **Column H** calculate a stress bonus (**Bonus 2**) which is **£100** for all staff in Finance or Training and **£20** for everyone else, using the **IF** function with a nested **OR** function.
   Example answer **=IF(OR(D4=”Finance”,D4=”Training”),100,20)**.
9. Format **Column I** as numeric with 0 decimal places. In this column use the **YEAR** function to find the year of birth for each staff member and add 60 to it. Name the column **Retirement Year**.
10. In **Column J** use **CONCATENATE** to join together **First** name and **Surname** with a space between them. Widen the cells to fit the largest name and name the column **Full Name**.
11. Close the workbook without saving.

If you experienced any difficulty completing this Revision refer back to the Driving Lessons in this section. Then redo the Revision.

Once you are confident with the features, complete the Record of Achievement Matrix referring to the section at the end of the guide. Only when competent move on to the next Section.