ADDITIONAL EXCEL FUNCTIONS

The following notes and exercises on additional *Excel* functions are based on the Grade 12 Examination Guidelines for 2016 recently issued by the DBE. As such, they represent an excellent *supplementary* resource towards preparing for the final CAT examinations. Work through this material carefully, together with your text book (which remains your primary source of reference), enlisting your teacher’s support where necessary. Best wishes for the exams!

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# DATE & TIME FUNCTIONS

As part of a further clarification of content that could be tested in Paper 1, the following Date and Time functions are listed in the 2016 Examination Guidelines for CAT:

* YEAR
* MONTH
* DAY
* DAYS
* DAYS360
* HOUR
* MINUTE
* TIME
* TODAY

Make sure you know how to use these functions.

## DATE FUNCTIONS

In order to understand the date functions, note that Excel stores dates as consecutive serial numbers, starting from 1900/01/01. For example, 2016/07/13 is 42 564 days after 1900/01/01. To illustrate this, enter a number and format it as a date, or vice versa.

We’ll start by looking at some date functions separately, then we’ll look at how to use them in practice together.

Open the spreadsheet **ExcelExercises** and work on the **DATE Functions** worksheet.

### **TODAY**

The TODAY function returns the serial number for the current date, already formatted as a date.

|  |  |
| --- | --- |
|  | Note that this function doesn’t require any *arguments* (i.e. anything between the brackets). |

ACTIVITY 1  
Insert a function in cell G2 to display the current date.

### **DAY**

The DAY function is used to extract the day of the month from a date, as a number from 1 to 31.

|  |  |
| --- | --- |
|  | Note that ‘serial\_number’ in the tool tip refers to a date in the Excel date/time format. |

ACTIVITY 2  
Insert a function in cell H2 to extract the day of the month from the date in cell E2. Copy the function down for the other employees.

### **MONTH**

The MONTH function is used to extract the month from a date, as a number from 1 (January) to 12 (December). The syntax for the MONTH function is =MONTH(serial\_number).

ACTIVITY 3  
Insert a function in cell I2 to extract the number of the month from the date in cell E2. Copy the function down for the other employees.

### **Year**

The Year function is used to extract the year from a date, as a simple 4 digit number. The syntax for the YEAR function is =YEAR(serial\_number)

ACTIVITY 4  
Insert a function in cell J2 to extract the year from the date in cell E2. Copy the function down for the other employees.

### **DAYS**

The DAYS function returns the number of days between two dates.

|  |  |
| --- | --- |
|  | Note the order of the arguments in the tool tip: the start\_date (2nd argument, the ‘smaller’ date) is subtracted from the end\_date (1st argument, the ‘larger’ date). The function in this example is thus equivalent to the formula =E2-C2. |

ACTIVITY 5  
Insert a function in cell K2 to determine the number of days between the dates in cells C2 and E2. Copy the function down for the other employees.

### **DAYS360**

The DAYS360 function calculates the number of days between two dates, based on a 360 day year instead of the normal 365.25 day year. The function is mainly used in accounting.

|  |  |
| --- | --- |
|  | The syntax for the DAYS360 function is similar to that for the DAYS function, except that it has an optional extra argument for [method] – used to specify whether the U.S. or European method should be used in the calculation. If this argument is FALSE, or is omitted, the U.S. method is used. |

ACTIVITY 6  
Insert a function in cell L2 to determine the number of days between the dates in cells C2 and E2, based on a 360 day year. Copy the function down for the other employees.

### **DATE** *[not listed in exam guidelines, but a very handy function]*

The DATE function is often used together with the DAY, MONTH and YEAR functions. Use it when you need to combine three separate values (year, month and day) to form a serial number that Excel can recognise as a date.

|  |  |
| --- | --- |
|  | You can enter cell references for the year, month and day (as in this example), or you can simply use numbers, such as =DATE(2010,6,30).  Note: always use 4 digits for the year. |

This function is often used to add a given number of years, months or days to an existing date. Suppose that the date 25 October 2010 is stored in cell E2, and we need to add two months and three days to this date.

|  |  |
| --- | --- |
|  | It may seem natural to refer simply to cell E2 in the DATE function, but this would return an error. The problem is that the ‘year’ argument should be a four digit number, the ‘month’ argument a number between 1 and 12, and the ‘day’ argument a number between 1 and 31, whereas the value currently stored in cell E2 is 40476 (formatted as the date 25 October 2010) – hence the error. |
|  | The correct way to formulate this function is first to extract the year, month and day from the date in cell E2. The YEAR function extracts the year (2010), the MONTH function the month (10), and the DAY function the day (25). The number of months and days to add to this date are then simply added to the ‘month’ and ‘day’ arguments, respectively. |

ACTIVITY 7  
Insert a DATE function in cell M2 to add 1 year and 1 month to the date in cell E2. Copy the function down for the other employees.

**=DATE(YEAR(E2)+1,MONTH(E2)+1,DAY(E2))** or **=DATE(J2+1,I2+1,H2)** since the separate functions were already performed in those cells.

### **WEEKDAY** *[not listed in exam guidelines, but a very handy function]*

WEEKDAY is used to return a number from 1 to 7 to identify the day of the week of a date, with a 1 being a Sunday and a 7 a Saturday.

|  |  |
| --- | --- |
|  | The syntax for Weekday can stay very simple and the second optional argument [return\_type], doesn’t need to be used. |

ACTIVITY 8  
Insert a function in cell N2 to determine what day of the week the date in E2 falls on. Copy the function down for the other employees.

## TIME FUNCTIONS

Now work on the **TIME Functions** worksheet.

In order to understand the time functions, it is important to realise that a given time is stored as a (decimal) part of a day. For example, when 0.25 is formatted as time, it is displayed as 06:00 (a quarter of a day). Applying the format yyyy-mm-dd hh:mm to the number 42 564.25 displays the number as 2016-07-13 06:00.

### **NOW**

The NOW function returns the serial decimal number for the current date and time, already formatted as a date with a time.

|  |  |
| --- | --- |
|  | Note that this function doesn’t require any *arguments* (i.e. anything between the brackets). |

ACTIVITY 9  
Insert a function in cell H1 to display the current date and time.

### **SECOND** *[not listed in exam guidelines, but a very handy function]*

The SECOND function is used to extract the seconds from a time, as a number from 1 to 59.

|  |  |
| --- | --- |
|  | Note that ‘serial\_number’ in the tool tip refers to a time in the Excel date/time format. |

ACTIVITY 10  
Insert a function in cell D2 to extract the seconds from the time in cell B2. Copy the function down for the other employees.

### **MINUTE**

The MINUTE function is used to extract the minutes from a time, as a number from 1 to 59. The syntax for the MINUTE function is =MINUTE(serial\_number).

ACTIVITY 11Insert a function in cell E2 to extract the minutes from the time in cell B2. Copy the function down for the other employees.

### **HOUR**

The HOUR function is used to extract the hours from a time, as a number from 1 to 23. The syntax for the HOUR function is =HOUR(serial\_number)

ACTIVITY 12  
Insert a function in cell F2 to extract the hours from the time in cell B2. Copy the function down for the other employees.

### **TIME**

The TIME function is similar to the DATE function, in that it is often used together with the HOUR, MINUTE AND SECOND functions, when you need to combine three separate values (hour, minute and second) to form a decimal number that Excel can recognise as a time.

|  |  |
| --- | --- |
|  | You can enter cell references for the hour, minute and second arguments (as in this example), or you can simply use numbers, such as =TIME(23,55,10). |

This function can be used to add a given number of hours, minutes or seconds to an existing time.

ACTIVITY 13Insert a TIME function in cell G2 to add 3 hours and 25 minutes to the time in cell B2. Copy the function down for the other employees.

**=TIME(HOUR(B2)+3,MINUTE(B2)+25,SECOND(B2))** or **=TIME(F2+3,E2+25,D2)** since the separate functions were already performed in those cells.

# LOOKUP functions

As part of a further clarification of content that could be tested in Paper 1, the following Lookup and reference functions are listed in the 2016 Examination Guidelines for CAT:

* LOOKUP
* VLOOKUP
* HLOOKUP

Open the spreadsheet **ExcelExercises** and work on the **LOOKUP Functions** worksheet.

## HLOOKUP FUNCTION

You should already be familiar with the VLOOKUP *(vertical lookup)* function. Thisfunction is used to look up a value in a table, and return a value from a cell in the corresponding row.

The HLOOKUP *(horizontal lookup)* function is similar to the VLOOKUP function, except that it uses rows instead of columns.

|  |  |
| --- | --- |
|  | Here we’re looking up the branch at which Andrew works, to find out what his branch code is. |
| E2 (lookup\_value) is the value in the *main table* we want to compare or look up (his branch).  Q$2:AB$4 (table\_array) is the *lookup table* (the list of branches and what each one’s branch code is).  Note: As with the VLOOKUP function, a value in the HLOOKUP’s lookup table needs to match your lookup\_value.  2 (row\_index\_num) is the number of the row in the *lookup table* which you want returned (the branch code is in the second row)  FALSE ([range\_lookup]) is an *optional argument* that lets you specify whether you want an exact match (FALSE) or an approximate match (TRUE). | |

ACTIVITY 14Insert a function in cell G2 to find the bonus for the branch at which Andrew Beach works. Use the range Q2:AB3 as the lookup table. Copy the function down for the other employees.

**=HLOOKUP(E2,Q$2:AB$4,3,FALSE)** or **=HLOOKUP(E2,$Q$2:$AB$4,3,FALSE)**

## LOOKUP FUNCTION

The LOOKUP function is used when you need to look in a single row or column and find a value from the same position in a second column. It differs from the VLOOKUP and HLOOKUP functions, in that the first column or row in the **lookup table** doesn’t necessarily have to be the one that must contain a match for the lookup value. Let’s look at an example.

In this example we have a **lookup table** with information about each department, specifying what gift they will receive and who is responsible for buying that gift.

|  |  |
| --- | --- |
|  | Firstly, note that the LOOKUP function can be used in two ways – the vector form (top of the tooltip) or the array form (bottom of the tooltip). The array form became obsolete with the introduction of VLOOKUP, so we’ll only use the vector form. In this scenario we are looking up Andrew’s department to determine which person is responsible for buying his gift. |
| D2 (lookup\_value) is the value in the *main table* we want to compare or look up (his department).  M$20:M$23 (lookup\_vector) is the *lookup column* (the column that contains the departments).  L$20:L$23 ([result\_vector]) is the column which contains the result you are looking for.  Note that the LOOKUP function doesn’t contain the TRUE/FALSE options for exact or approximate matches – all matches are approximate. | |

ACTIVITY 15Insert a function in cell I2 to find out what gift Andrew will receive. Use the LOOKUP table. Copy the function down for the other employees.

**=LOOKUP(D2,M$20:M$23,K$20:K$23)** or **=LOOKUP(D2,$M$20:$M$23,$K$20:$K$23)**

# COUNTIF(S), SUMIF(S) & AVERAGEIF(S)

The 2016 Examination Guidelines for CAT states: “Candidates may (but are not restricted to) use the SUMIFS and COUNTIFS functions to solve problems rather than using the existing functions to create complex functions. The SUMIFS and COUNTIFS may be used to answer questions.”

We have decided to include the AVERAGEIF(S) functions here, as they are very useful for determining an average value when one or more criteria are specified. (Note, however, that these functions are NOT mentioned in the Exam Guidelines.)

Open the **ExcelExercises** spreadsheet and work on the **IFS Functions** worksheet.

## COUNTIF(S)

### explanation

Everyone is familiar with the normal COUNTIF function – this enables us to count how many cells adhere to a certain criteria. The COUNTIFS function simply counts the number of cells that adhere to more than one criteria.

Let’s look at an example. We want to see how many people at the Bloubosrand branch are over 40 years of age.

|  |  |
| --- | --- |
|  | The arguments for this function are pairs of CRITERIA RANGES (which cells to examine) and CRITERIA (what to test in each range). You can continue adding range/criteria pairs, up to a maximum of 127. The first range/criteria pair is compulsory, while the rest are optional. |

Note: Remember that each additional range must have the same number of rows and columns as the first range. (for example, d2:d39 and f2:f39 – can’t go to f40.) This is applicable to countifs, sumifs and averageifs.

|  |  |
| --- | --- |
| Another example of a COUNTIFS function would be to see how many people are between 40 and 50 years of age. |  |

Note: It may be easier to use the function builder to do a COUNTIF, as quotation marks are automatically added where required.

### ACTIVITY 16

1. Insert functions in cells B43 to B46 to count how many Males work in each department.

* Easiest (because it can be copied down) **=COUNTIFS(B$2:B$39,"M",E$2:E$39,A43)** or **=COUNTIFS($B$2:$B$39,"M",$E$2:$E$39,A43)**
* Most effort (because the arguments will have to be adjusted for each cell individually) **=COUNTIFS(B2:B39,"M",E2:E39,"Management")**

1. Insert functions in cells B48 to B51 to, count how many Females work in eachdepartment. As above.
2. Insert functions in cells B54 to B65 to count how many Males work at each branch.

* Easiest (because it can be copied down) **=COUNTIFS(B$2:B$39,"M",F$2:F$39,A54)** or **=COUNTIFS($B$2:$B$39,"M",$F$2:$F$39,A54)**
* Most effort (because the arguments will have to be adjusted for each cell individually) **=COUNTIFS(B2:B39,"M",F2:F39,"Blairgowrie")**

1. Insert functions in cells D54 to D65 to count how many Females work at each branch. As above.

Hint: always use absolute referencing to ‘lock’ the ranges of Countif(s), Sumif(s) and Averageif(s) functions.

## SUMIF(S)

### explanation

The normal SUMIF is one of the more challenging functions, but it helps to use the function builder and pay close attention to the syntax. A SUMIF is used to sum the values in a range of cells (the SUM RANGE) that adheres to a single range/criteria pair.

|  |  |
| --- | --- |
| An example of a normal SUMIF would be to add up the salaries of all the males: |  |

Note: It is helpful to remember that the first two arguments of the normal SUMIF are the same as those for the COUNTIF. The third argument Sum\_range is then just added at the end.

|  |  |
| --- | --- |
| The SUMIFS function differs from the COUNTIFS function, in that it starts with the Sum\_range (the numbers that must be added), and is followed by one or more range/criteria pairs, up to a maximum of 127. In this example we add up the salaries of all males over 40 years of age. |  |

### ACTIVITY 17

1. Insert functions in cells C43 to C46 to calculate the total salaries of the males in each of the departments.

* Easiest (because it can be copied down) **=SUMIFS(G$2:G$39,B$2:B$39,"M",E$2:E$39,A43)** or **=SUMIFS($G$2:$G$39,$B$2:$B$39,"M",$E$2:$E$39,A43)**
* Most effort (because the arguments will have to be adjusted for each cell individually) **=SUMIFS(G2:G39,B2:B39,"M",E2:E39,A43)**

1. Insert functions in cells C48 to C51 to calculate the total salaries of the females in each of the departments. As above.
2. Insert functions in cells C54 to C65 to calculate the total salaries of the males at each of the branches.

* Easiest (because it can be copied down) **=SUMIFS(G$2:G$39,B$2:B$39,"M",F$2:F$39,A54)** or **=SUMIFS($G$2:$G$39,$B$2:$B$39,"M",$F$2:$F$39,A54)**
* Most effort (because the arguments will have to be adjusted for each cell individually) **=SUMIFS(G2:G39,B2:B39,"M",F2:F39,A54)**

## AVERAGEIF(S) *[not listed in exam guidelines, but a very handy function]*

### explanation

The AVERAGEIF function is very useful when you want to calculate the average value of cells that meet a single criteria. For example, a teacher could use this function to calculate the average mark of learners for a test, excluding those who were absent.

|  |  |
| --- | --- |
|  | In this example, the range and the Average\_range are the same. |

|  |  |
| --- | --- |
| Let’s look at another example. Say we want the average age of people in the Management department.  Here the range and criteria come first, as in a COUNTIF. Then we add the range that we want to average (the Average\_range) as the third argument. |  |

|  |  |
| --- | --- |
| The syntax of the AVERAGEIFS function is similar to that of a SUMIFS, starting off with the Average\_range and then allowing you to add further range/criteria pairs, up to a maximum of 127. In this example we calculate the average age of males with a salary of more than R20 000. |  |

### ACTIVITY 18

1. Insert a function in cell G41 to calculate the average salary of all the male employees. **=AVERAGEIF(B2:B39,"M",G2:G39)**
2. Insert a function in cell G42 to calculate the average age of all employees whose name starts with an N. **=AVERAGEIF(A2:A39,"N\*",D2:D39)**
3. Insert a function in cell I41 to calculate the average salary of men in the Sales department. **=AVERAGEIFS(G2:G39,B2:B39,"M",E2:E39,"Sales")**
4. Insert a function in cell I42 to calculate the average age of women who work at the Lanseria branch. **=AVERAGEIFS(D2:D39,B2:B39,"F",F2:F39,"Lanseria")**

Note: Never specify criteria by referencing cells in the ‘raw’ data. For example, in question 1 above, the full data range being worked with is A2:H39, so the function *=AVERAGEIF(B2:B39,B38,G2:G39) would be unacceptable. This is because the criteria specified in the second argument of the function (B38) – even though* ***currently*** *“M” for male – is not fixed but is liable to change (it may even have been entered incorrectly). In this case, if there isn’t a standalone “M” in a cell outside of the data range, e.g. as a label or a heading, use the literal text value “M” instead.*

# LOGICAL FUNCTIONS

Although these functions are not specifically mentioned in the exam guidelines, they can be very useful when combined with the IF function, eliminating the need to use additional columns for temporary calculations (or other lengthy workarounds).

Open the **ExcelExercises** spreadsheet and work on the **Logical Functions** worksheet.

## SIMPLE LOGICAL TEST

### EXPLANATION

|  |  |
| --- | --- |
|  | An IF function performs a logical test first, and instead of returning a simple TRUE or FALSE, allows one to specify a custom value in place of the TRUE or FALSE. |

One can also perform a simple logical test on its own (apart from an IF function).

In a logical test one tests a single cell for a condition using the operators = , > , < , or a combination of these. Let’s look at some examples.

|  |  |
| --- | --- |
|  | The first = is there simply to introduce a formula (or a function) and does not form part of the logical test itself. In this example we are testing whether B2 is equal to F. The formula then returns a simple TRUE or FALSE. |

|  |  |
| --- | --- |
|  | The formula in this example tests whether the value in C2 (the person’s age) is over 60, and again returns a simple TRUE or FALSE. |

### ACTIVITY 19

1. In cell H2, test whether the employee is a male. The test must display TRUE if that person is a male, and FALSE if that person is a female. Copy this formula down for the other employees. **=B2="M"**
2. In cell I2, test whether the employee is 25 years or younger. The test must display TRUE if the age is 25 or lower, and FALSE if not. Copy this formula down for the other employees. **=C2<=25**

## OR FUNCTION

### EXPLANATION

This function tests for two conditions – if **either one or both** of the conditions are TRUE, the function will return TRUE. If **both** conditions are FALSE, the function will return FALSE. Let’s look at an example.

Suppose the company wishes to send all the employees in the Sales department, as well as all the employees at the Fairland branch, on a course. For this scenario, we will use the OR function.

|  |  |
| --- | --- |
|  | In this example, our first logical test is whether their department is Sales, and the second whether they work at the Fairland branch. If **either one or both** of these two conditions are true, the answer will be TRUE. Note the syntax: the logical tests are separated by a comma. Only the first logical test is compulsory, thereafter you can enter as many as 255! |

Note: an optional part of a function is indicated by square brackets [] in the tool tip.

### ACTIVITY 20

1. In cell J2, test whether the employee is either a Female, or over the age of 40. Copy this function down for the other employees. **=OR(B2="F",C2>40)** Notice that the functions in cells J4 (female younger than 40) and J10 (male older than 40) both evaluate to TRUE.
2. In cell K2, test whether the employee’s salary is less than R10 000, or if his/her department is the Workshop. Copy this function down for the other employees. **=OR(F2<10000,D2="Workshop")** Notice that the functions in cells K2 (earns less than R10 000 and works in the Workshop), K14 (earns less than R10 000 but works in Spare Parts) and K15 (works in the Workshop but earns over R10 000) all evaluate to TRUE.

## AND FUNCTION

### EXPLANATION

This function also tests for two conditions – if **both** conditions are TRUE, the function will return TRUE. If **either one or both** of the conditions are FALSE, the function will return FALSE. Let’s look at an example.

Suppose employees in the Workshop who earn R10 000 or less staged a protest, and need to receive an increase.

|  |  |
| --- | --- |
|  | In this example we test whether the employee works in the Workshop AND earns R10 000 or less. Only if **BOTH** these conditions are true, will the answer be TRUE. The syntax is the same as that for the OR function. |

### ACTIVITY 21

1. In cell L2, test whether the employee is 35 or younger and works at the Randpark Ridge branch. Copy this function down for the other employees.**=AND(C2<=35,E2="Randpark Ridge")** Notice that the function in cell L2 (works at Randpark Ridge, but older than 35) evaluates to FALSE. Only the functions in cells L5 and L8 meet both conditions and evaluate to TRUE.
2. In cell M2, test whether the employee’s salary is more than R15 000 and his/her department is Management. Copy this function down for the other employees.**=AND(D2="Management",F2>15000)** Notice that the function in cell M7 evaluates to FALSE, even though he earns more than R15 000 (because he works in Sales, not in Management). The results in column M evaluate to TRUE only if both the conditions are true.

## COMBINING OR FUNCTION WITH IF

### EXPLANATION

An OR function can be very useful when combined with an IF function, and can be used instead of a Nested if (which uses a second IF in the Value\_if\_false box). Let’s use one of the previous examples to illustrate this.

Suppose the company wishes to send all employees in the Sales department, as well as all employees at the Fairland branch, on a course. The word ‘Course’ must be displayed in the applicable cell, if either of these conditions is met; otherwise the cell must remain blank:

|  |  |
| --- | --- |
|  | So as you can see, instead of using a single logical test in the IF function, we used the Or function. The same result could be achieved by using a Nested IF. |
|  |

### ACTIVITY 22

1. The company noticed that there are a lot of complaints about the staff at the Ferndale branch. They’ve decided to offer a refresher course in customer service for everyone at the Ferndale branch, as well as all employees who started after 2013.

Insert a function in cell N2 that will display the text “Customer Service Training” if Andrew works at the Ferndale branch or started working at the company after 2012. If neither of these conditions is met, the cell must remain blank. Copy this function down for the other employees.

**=IF(OR(E2="Ferndale",G2>"2012-12-31"),"Customer Service Training","")**

Note: a date can also be used as a criteria – simply format it the same as the computer’s short date. E.g. >"1990/01/01". It is essential to add the quotation marks around the date.

## COMBINING AND FUNCTION WITH IF

### EXPLANATION

An AND function can be equally useful when combined with an IF function, and can be used to replace a Nested IF. Let’s use a previous example (discussed under the AND FUNCTION) and combine it with an IF function.

|  |  |
| --- | --- |
|  | Suppose employees in the Workshop who earn R10 000 or less staged a protest, and need to receive an increase of 10%. Work out and show their new salary if both conditions are met, or show their current salary if either one of the conditions is not met. Your function will look like this (note that the second logical test is cut off a little – it reads F2<=10000). Only if both these conditions are true, is the 10% increase applied. |

Note: You can also type F2\*110% or F2+F2\*0.1 in the Value\_if\_true box.

|  |  |
| --- | --- |
| The Nested If alternative, looks like this: |  |

### ACTIVITY 23

1. Employees in the Management department who have a salary between R15 000 and R20 000 will receive a performance bonus of R2 000 added to their salary. If employees do not meet either of these conditions, their salary will remain unchanged.

Insert a function in cell O2 to calculate the amount that Andrew will receive. Copy this function down for the other employees.

**=IF(AND(D2="Management",F2>=15000,F2<=20000),F2+2000,F2)** Notice that only cell O2 reflects the added bonus.

1. Use conditional formatting to indicate which values in column N are greater than the values in column F.

Solution: apply conditional formatting to cells O2:O39 – choose Highlight Cell Rules 🡪 Greater Than... and click on cell F2. Remove the absolute cell referencing from the formula in the box. (You may find it easier to delete the entire contents of the box, and retype =F2). This allows all the selected cells in column O to reference their corresponding cells in column F.

