Excel Date and Time Calculations

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Introduction

Everyone knows that Excel works brilliantly with numbers, but not everyone is aware that Excel can work just as well with dates and to a lesser extent, with times.

In fact Excel treats dates just like numbers. Day 1 in Excel is 1/1/1900.

While days are treated as whole numbers, times are treated as fractions. Hence, 1.5 is noon on 1/1/1900.

You have probably seen what happens when the format is removed from a date cell (Clear Formats) or you copy and use paste special values from a date cell into another cell.

It displays a number above 40,000. This number represents how many days since 1/1/1900.

We will examine dates first and then have a look at how you work with times in Excel.

When working with dates formatting can be an issue.

When referring to months in column headings, always use the 1st of the month.

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Date Calculations

Since dates are treated like numbers doing calculations based on dates is reasonably straight forward. You need to be aware that Excel will apply a default format to cells it thinks are dates. That isn't always what you want, or expect.

Default Date Formats

C2 =+B2-A2

	A	B	C
1	Start Date	End Date	Number of days
2	1/02/2014	28/02/2014	27/01/1900

In this example if you have two dates and subtract one date from the other Excel will automatically default the format of the calculation cell (C2) to a date format.

C2 =+B2-A2

	A	B	C
1	Start Date	End Date	Number of days
2	1/02/2014	28/02/2014	27

In this case that doesn't help and you can either remove the format using Clear Formats icon or apply a number format to correct it.

The previous example shows that subtraction calculations are exclusive. In the example subtracting the first day of the month from the last day of the month gives you one day less than the number of days in the month. It is basically 28 - 1 = 27.

There is a formula to calculate the number of days in a given month and it will be covered later in the session.

Add days to a date

E3 =+E2+7

	D	E	F
1		End of Week	
2		1/02/2014	
3		8/02/2014	
4		15/02/2014	
5		22/02/2014	
6		1/03/2014	
7		8/03/2014	

A common requirement is to enter a date, say the end of the week, and then use a formula to calculate the end of subsequent weeks.

That is as easy as adding 7 to the date.

Cell E3 has been copied down to create a list of Sunday weekending dates.

If you need to add weekdays or workdays to a date you can use the WORKDAYS function. The WORKDAYS function allows you to specify a start date and add a number of weekdays to it to arrive at a completion date. You can include a list of holidays to be excluded the weekdays.

WORKDAYS(Start_Date,Days,Holidays)

Start_Date - usually a cell reference containing a date

Days - the number of workdays to add to the Start_Date

Holidays - (optional) - is a range containing a list of dates to be treated as public holidays and to be excluded from the calculation

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	A	B	C	D	E	F
1	**Start Date**	**Weekdays to add**	**Completion date weekdays**	**Completion date with Holidays**		**Holidays**
2	2/02/2014	12	18/02/2014	18/02/2014		1/01/2014
3	31/12/2013	2	2/01/2014	3/01/2014		27/01/2014
4	3/02/2014	20	3/03/2014	4/03/2014		3/03/2014

The formula in cell C2 is

=WORKDAY(A2,B2)

This has been copied down the column. This formula adds weekdays to the start date. No public holidays are taken into account.

The formula in cell D2 is

=WORKDAY(A2,B2,$F$2:$F$4)

This has been copied down the column. This formula adds weekdays to the start date but the dates in F2:F4 are treated as public holidays and not worked.

There are no public holidays in February so there is no difference between C2 and D2, but there are differences between rows 3 and 4 because there are public holiday dates in the date ranges involved.

Adding months to Date

We saw how easy adding a week to a date is. Adding a month is more difficult because of our different length months. You can use the EDATE function to easily add a number of months to a date.

EDATE(Start_Date,Months)

Start_Date - usually a cell containing the start date

Months - the number of months to add to the date, usually a keyed in value. May be 1 to add a month or 3 for quarters.

C2 =EDATE(A2,B2)

	A	B	C
1	**Start Date**	**Months to add**	**End Date**
2	1/01/2014	2	1/03/2014
3	15/01/2014	2	15/03/2014
4	31/01/2014	2	31/03/2014
5	29/01/2014	1	28/02/2014
6	30/01/2014	1	28/02/2014
7	31/01/2014	1	28/02/2014

The formula in cell C2 is

=EDATE(A2,B2)

This has been copied down the column.

As you can see it correctly handles the end of month issues for February in rows 5, 6 and 7.

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First and Last day of the Month

Two common dates that you need to calculate are the first and last days of the month.

There are two functions that both handle these two requirements. The EOMONTH function handles end of month calculations and can be manipulated to arrive at the first of the month.

The EOMONTH function returns the last day of the month for the month it refers to. You can add a number of months to a date and return the last day of the month for the calculated month.

EOMONTH(Date,Months)

Date – usually a cell containing a date

Months – the number of months to add to the date.

The DATE function allows you to build a date based on three inputs, for year, month and day.

DATE(Year,Month,Day)

Year – a number representing the year of the date

Month - a number representing the month of the date. If a number greater than 12 is used it will adjust the month – eg 13 will return January of the next year referred to in the year argument.

Day - a number representing the day of the date. If a number greater than the last day of the month it will adjust the month – eg 32 in January will refer to 1st February. Large values can also increment the year.

	A	B	C	D	E	F
1	Start Date	Add months	First - EOMONTH function	Last - EOMONTH function	First - DATE function	Last - DATE function
2	10/01/2014	3	1/04/2014	30/04/2014	1/04/2014	30/04/2014
3	10/01/2014	0	1/01/2014	31/01/2014	1/01/2014	31/01/2014
4	15/02/2014	4	1/06/2014	30/06/2014	1/06/2014	30/06/2014
5	31/01/2014	1	1/02/2014	28/02/2014	1/02/2014	28/02/2014

The formula in cell D2 is

=EOMONTH(A2,B2)

This is straightforward as it takes the start date and adds a number of months and return the month end date for that calculated month.

The formula in cell C2 is

=EOMONTH(A2,B2-1)+1

This is less straightforward. It uses the fact that the EOMONTH returns the last day of the month and removes 1 from the added month (inside the brackets) and then adds one to the result (outside the brackets) which in effect adds one to the last day of the previous month to arrive at the first day of the current month. (You may need to read that a few times.)

The formula in cell E2 is

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=DATE(YEAR(A2),MONTH(A2)+B2,1)

This uses the YEAR and MONTH functions (they return their respective values from a date) to build a date with the day value being hard-keyed as 1.

The formula in cell F2 is

=DATE(YEAR(A2),MONTH(A2)+B2+1,0)

Note the use of a zero day. This takes advantage of the way the day value works in the DATE function. One is added to the month calculation and then 0 is used for the day. Zero is one less than one and hence it adjusts the date back to the last day of the previous month, which is why one was added to the month.

Today's Date

	A	B
1	Due dates	Overdue
2	10/02/2014	Yes
3	11/02/2014	Yes
4	12/02/2014	Yes
5	13/02/2014	Yes
6	14/02/2014	Yes
7	15/02/2014	Yes
8	16/02/2014	Yes
9	17/02/2014	Yes
10	18/02/2014	Yes
11	19/02/2014	
12	20/02/2014	
13	21/02/2014	
14	22/02/2014	
15	23/02/2014	
16	24/02/2014	
17	25/02/2014	
18	26/02/2014	
19	27/02/2014	
20	28/02/2014	
21	1/03/2014	
22	2/03/2014	
23	3/03/2014	
24		

Sometimes you need to do calculations based on today's date eg has a due date expired.

You can uses today's date in a formula by using the function TODAY(). This provides the current day's date. This is dynamic, it uses your computer's date. If you need to return the date and time use the NOW() function which include the fraction for the time.

The formula in cell B2 is

=IF(A2<TODAY(),"Yes","")

This formula has been copied down.

Based on the date that this manual was created the list is accurate.

Compare it to the report on the day of the webinar.

If you want to enter today's date in a cell so that is doesn't change then use the keyboard shortcut Ctrl + ; this is not dynamic, it is a data entry and won't change.

Current time is Ctrl+ Shift + :

Try using the mouse to right-drag a date and see the Fill Weekdays option - handy for rosters.

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Days of the week

If you need to work with Monday, Tuesday etc there are a couple of ways to do it. You can convert the date into its day equivalent using a format or the TEXT function. You can also use the WEEKDAY function.

Weekdays - format

To identify what day of the week a date is, you can use a custom number format.

In the Custom Category of the Number tab of Format Cells you can use

dddd

to display the full day name or

ddd

to display the short day name.

Column B has a formula that links to column A. This means the date value is still in the cell, but it is displayed as the day of the week.

Weekdays using a TEXT function

Cell C2 has the formula

=TEXT(A2,"dddd")

This returns the text as shown to the cell - this is no longer a date, but text.

The WEEKDAY Function

The WEEKDAY function returns a number from 1 to 7.

1 = Sunday, 2 = Monday through to 7 = Saturday.

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Calculation using the WEEKDAY function

The SUMPRODUCT function, which is Excel's most versatile function, can use other functions within its brackets to perform different types of summing.

The formula in cell F2 is

=SUMPRODUCT((WEEKDAY($A$2:$A$21)=D2)*($B$2:$B$21))

	A	B	C	D	E	F
1	**Date**	**Amount**			**Day**	**Totals**
2	1/02/2014	4,435		1	Sunday	11,665
3	2/02/2014	4,073		2	Monday	8,299
4	3/02/2014	2,074		3	Tuesday	7,373
5	4/02/2014	3,726		4	Wednesday	9,878
6	5/02/2014	2,275		5	Thursday	6,328
7	6/02/2014	1,938		6	Friday	7,018
8	7/02/2014	3,646		7	Saturday	8,134
9	8/02/2014	1,193				
10	9/02/2014	3,403			**Total**	**58,695**
11	10/02/2014	1,689				
12	11/02/2014	1,495				
13	12/02/2014	4,543				
14	13/02/2014	2,656				
15	14/02/2014	3,372				
16	15/02/2014	2,506				
17	16/02/2014	4,189				
18	17/02/2014	4,536				
19	18/02/2014	2,152				
20	19/02/2014	3,060				
21	20/02/2014	1,734				
22						
23	**Total**	**58,695**				
24						

The formula has been copied down.

This formula summarises the listing in columns A and B into total weekday sales.

TEXT Function and Dates

If you need to create automated headings or narrations then you may have struck this issue with Excel.

C2 =A2&" "&B2

	A	B	C
1	**Text**	**Date**	**Joined**
2	Report For	1/02/2014	Report For 41671
3			

The formula in cell C2 is

=A2&" "&B2

The & symbol joins text together.

You can see that the number of the date has been displayed rather than the words.

To create an automated heading you can use the TEXT function to convert the date to text.

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	A	B	C	D
1	**Text**	**Date**	**Joined**	**TEXT solution**
2	Report For	1/02/2014	Report For 41671	Report For February 14

The formula in D2 is

=A2&" "&TEXT(B2,"mmmm yy")

The format which is the second part of the TEXT function uses the same type of formats seen in the Custom Number format earlier. You must enclose them in quotation marks.

You can also use this technique to format $ values in narrations or sentences.

Workday Calculation between two dates

Another type of workday calculation is you have a start date and an end date and you need to calculate how many workdays in between. The NETWORKDAYS function handles this type of calculation.

NETWORKDAYS(Start_Date,End_Date,Holidays)

Start_Date and **End_Date** are usually cell references.

Holidays - is a range containing dates to be treated as public holidays and not worked.

	A	B	C	D	E	F
1	**Start Date**	**End Date**	**Weekdays**	**Workdays**		**Holidays**
2	1/02/2014	28/02/2014	20	20		3/03/2014
3	1/02/2014	15/03/2014	30	29		18/04/2014
4	1/02/2014	30/04/2014	63	59		21/04/2014
5						25/04/2014

The formula in cell C2 is

=NETWORKDAYS(A2,B2)

This calculates weekdays between the two dates, as it has no holiday range.

The formula in cells D2 is

=NETWORKDAYS(A2,B2,$F$2:$F$5)

This calculates workdays as it includes a list of holidays to exclude from the calculations.

There is also a NETWORKDAYS.INTL (Excel 2010 and later versions) that allows you to specify weekends other than Saturday and Sunday.

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Time Calculations

As mentioned earlier time is treated as a fraction of a day.

0.25 = 6am

0.5 = noon

0.75 = 6pm

Time entry

The main issue you have with time is whether to treat is as a decimal, as above, or as per the normal digital time display eg 6:15 or 18:45.

To enter time in a cell you need to use the colon to separate the hours and the minutes.

If the minutes are zero, then you can just enter the hours followed by the colon.

If you type 11:1 and press Enter you are in fact entering one minute past 11 not 10 minutes passed.

You must include the zero at the end for minutes.

Once the hours are entered then you can subtract one from the other to get the difference in hours.

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E2 =+D2*C2

	A	B	C	D	E
1	Start Time	End Time	Hours	Rate	Hours x Rate
2	8:30	11:00	2:30	$20.00	$2.08
3					

Once you have hours in a cell there are some limitations to using them in calculations.

If you multiply by hours you will find this issue.

E2 =+D2*C2*24

	A	B	C	D	E
1	Start Time	End Time	Hours	Rate	Hours x Rate
2	8:30	11:00	2:30	$20.00	$50.00

Hours are still a fraction of a day.

Hence, to do any multiplications you need to multiply the hours by 24 to convert them to a decimal value.

C2 =+B2-A2

	A	B	C	
1	Start Time	End Time	Hours	R
2	20:30	1:30	###########	
3				

Another problem arises when the time different goes over a day.

Excel fills the cell with # signs when it can't perform the time calculation.

C2 =IF(B2>A2,B2-A2,B2+1-A2)

	A	B	C	D	E
1	Start Time	End Time	Hours	Rate	Hours x Rate
2	20:30	1:30	5:00	$20.00	$100.00
3					

The adjusted formula in cell C2 that handles going over a day is

=IF(B2>=A2,B2-A2,B2+1-A2)

The solution involves adding a whole day (1) to the end time to make it more than the start time and then the subtraction works.

Adding up time

C7 =SUM(C2:C6)

	A	B	C	D	
1	Start Time	End Time	Hours	Rate	Ho
2	20:30	1:30	5:00	$20.00	
3	6:30	16:30	10:00	$20.00	
4	7:30	14:30	7:00	$20.00	
5	9:30	18:30	9:00	$20.00	
6	10:00	14:00	4:00	$21.00	
7			11:00		
8					

Another problem you can face with time is that Excel won't let you display more the 24 hours.

To get around this limitation you need to use a Custom Number format to force Excel to display hours larger than 24.

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The custom number format to use is

[h]:mm

Alternative Hours Difference Formula

Instead of using the IF function to determine the difference we can also use the MOD function.

In cell F2 enter the following formula

=MOD(B2-A2,1)

The MOD function returns the remainder after diving one positive number by another positive. It works a little differently with negative numbers. I will give an example during the session to explain.

It finds the difference between the number and the closest lowest exact multiple of the divisor – in this case 1. In the formula below it gives us the difference between -1 and -0.7916666667. Or 0.2183333 – which in the value we want. Remember it needs to be converted into a Time format.

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Other Date Calculations

If you need to calculate how many years or months between two dates you can use the DATEDIF function. This function is unusual in that it doesn't appear in Excel's help system and there is no help to use it as you create it.

Warning: Apparently this function can be unstable in some circumstances.

DATEDIF(Start_Date,End_Date,Type)

Start_Date and **End_Date** are usually cell references.

Type - is a text string in quotation marks that specifies the type of calculation to perform. See table below.

Type	Description
y	Full years between dates
m	Full months between dates
ym	Remainder months after years
md	Remainder days after months
yd	Remainder days after years

Examples

	A	B	C	D	E	F
1	Start Date	End Date	Full Years Between	Full Months Between	Completed months in excess of year	Completed Days in Excess of month
2	1/02/2012	1/02/2014	2	24	0	0
3	6/09/1962	19/02/2014	51	617	5	13

Total number of completed years between dates - the formula in cell C2 is

=DATEDIF(A2,B2,"y")

Total number of completed months between dates - the formula in cell D2 is

=DATEDIF(A2,B2,"m")

Total remaining months after completed years - the formula in cell E2 is

=DATEDIF(A2,B2,"ym")

Total remaining completed days after completed months - the formula in cell F2 is

=DATEDIF(A2,B2,"md")

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Common Date Calculations

Automated Date Ranges

In financial models and some reports you typically have a central date range that specifies the dates to be used in all the sheets in the model and report.

One way to automate this is to use the EDATE function. You have a starting date and then add a month to it or 3 months for a quarter.

	A	B	C	D	E	F	G	H	I
1	Months	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14
2									
3	Quarters	Sep-13	Dec-13	Mar-14	Jun-14	Sep-14	Dec-14	Mar-15	Jun-15
4									

Formula in C1 is

=EDATE(B1,1)

Formula in C3 is

=EDATE(B3,3)

Days in the month

If B1 contains a date the following formula will calculate how many calendar days in the month.

=DAY(DATE(YEAR(B1),MONTH(B1)+1,0))

Dates With Times

Sometimes when you import dates into Excel they may include a time fraction. The time is typically redundant. To remove a time from a date use the TRUNC function (short for truncate) which will remove the decimal values leaving just the date as a whole number. It doesn't do any rounding.

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