

Gerald's Column *by Gerald Fitton*

For some time now and in response to a relatively small number of letters I have been working on an article about Date and Time functions. What was a trickle has become a flood. As a statistician I have to ask "Is it by chance alone that this month I have received more questions about Date and Time functions than I did during the whole of the previous year?" I guess that the answer has to be "No!" and that leads me to wonder what is the origin of all this concern.

The Year 2000

In the past few weeks there has been more than the usual media interest in the problems many computer systems will face at the turn of the century. It would seem that, back in the 1960s, when computers began to proliferate, the software designers wanted to reduce the number of bits used in their representation of dates and so they left out the century. Later, around 1980, the originators of the Microsoft Disk Operating System, often referred to as MS DOS (but not designed by Microsoft) followed this lead. For example the year 1999 is stored in MS DOS based computers as the year 99. One year after 1999 we in the Acorn world will celebrate the year 2000 whereas those with MS DOS will find their computers are storing the year 00. Having the year 2000 stored as 00 wouldn't be too bad if there was a way of interpreting it as 2000; unfortunately most MS DOS based packages interpret the year stored as 00 as being the year 1900. Similar problems exist for mainframe and mini computers used by many prestigious companies for their accounting records. If we include mainframes, mini computers and PCs then, according to the media pessimists, it will cost this country about a billion pounds (sterling) to modify software to include the century in the representation of the year after 1999. The estimated bill for the whole world is £200B.

I suppose that it doesn't really matter whether I have hit on the cause of my flood of correspondence or not. The fact is that I have had a lot of letters requesting information about the use of Date and Time functions recently and so the time has come for a few comments about Time and Date functions used by Archimedes spreadsheet packages.

Dates and Times in Eureka – Schema – PipeDream & Fireworkz

This article is intended as an introductory article. I shall deal with the basics and give a few simple examples. I shall reserve for later articles more extensive examples of usage. If you have a contribution to this discussion then it will be most welcome. My address is that of Abacus Training on the back cover of Archive.

I have looked at the way in which Eureka, Schema, PipeDream and Fireworkz display and handle dates and times. I had hoped that I would be able to treat all these packages within the one article – but the differences are too great. In summary Eureka will display dates and times but I have found that using Eureka for date or time arithmetic is more than a little difficult. Schema has an extensive range of date and time functions which are compatible with those of Lotus; there is a great deal of flexibility in the way in which dates and times can be displayed and manipulated. As you might imagine Fireworkz and PipeDream, both from Colton Software, display and operate similarly and (I might be prejudiced) but I find that the way in which they handle date and time functions to be much

more user friendly than (the more flexible) Schema.

In this article I shall concentrate mainly on PipeDream and Fireworkz partly because I'm prejudiced but also because more than three quarters of my date and time correspondence has been from PipeDream (not even Fireworkz) users. Even so, if you use a different spreadsheet (or none at all) I promise that you will find a few nuggets of gold scattered amongst the dross!

Formats for the Date

One of the functions contained by PipeDream and Fireworkz is the function (now) which, if you type it into a PipeDream number slot, it will return something such as:

25 Jan 1997 07:51:12 or maybe 25.1.1997 07:51:12

In PipeDream, by executing the command <Ctrl O>, you can select from three formats called Text, English and one which I suggest that you never use, American. There are two reasons why I recommend you ignore the American format. The first is that, when the date is one of the first 12 in the month, the American format (month.day.year), 1.25.1997, could be misinterpreted. In order to avoid ambiguity when I use PipeDream I always use the Text format, 25 Jan 1997. I will explain the second reason for avoiding the American format in the next section headed "Dates in the Formula Line".

In Fireworkz the display is controlled by applying a Style to a slot containing a Date. The sub menu containing a selection of Date formats is Style – Change – Number – Date. You can have a wide range of Date Styles including 25 Jan 1997, 25 Jan 97, 25th January 1997, 25/1/97, January 25th, 1997 (note the comma is optional), 25 January (without the year) and many others. You can devise your own Date Styles and, unlike PipeDream, you can vary the Style from cell to cell.

Dates in the Formula Line

It doesn't matter which Fireworkz Style you have chosen for your display or whether you have chosen to display the date in Text or English PipeDream format (American format is an exception – see below), in both the Fireworkz and PipeDream formula line it is always in the English format, 25.1.1997, and includes the century. The English format for the date consists of three numbers separated by full stops. In the example "25.1.1997" the 1 represents the first month of the year namely January. When entering a date you can insert leading zeros such as "25.01.1997" but, as soon as you tap <Return> (or click on the green tick) the leading zeros will be removed by both PipeDream and Fireworkz.

The only exception to English format in the formula line is the PipeDream American format (not recommended) in which case the formula line not only displays the American format but you are required to enter the date in that format. Worse than that, if you try to port a PipeDream file containing Dates in American format to Fireworkz then the resulting Fireworkz file will contain the wrong date. Make sure that you execute <Ctrl O> and change your PipeDream Dates back to Text or English before you port to Fireworkz.

Both PipeDream and Fireworkz interpret truncated years such as 97 (in the formula line) as

being in this century (rather than the year 97 AD). If, instead of entering 25.1.1997 into the formula line you had entered 25.1.97 then PipeDream and Fireworkz both assume that you mean 1997 (rather than any other century) and display the result as 25.1.1997. Not only is this result displayed in the cell (in the body of the spreadsheet) but also (as soon as you tap <Return> or click on the green tick) the truncated year is replaced with the full year in the formula line.

After 1999 (when we reach the year 2000) it will be necessary to enter the 20 in addition to the last two digits of the year in order to force the year into the new century.

A Problem with the Abbreviated Year

One question which I have been asked all too often is why, in both PipeDream and Fireworkz, formula such as `date(97+5,1,25)` when entered in the formula line return the wrong year (they return 25 Jan 102 or something similar in the year 102 AD).

In my view they don't fail. Firstly, if the formula is entered without truncating the year, for example as `date(1997+5,1,25)`, the correct date, 25 Jan 2002, is returned. Secondly, I would expect the convention for working out the date would be to add the 5 to the 97 to get 102 before evaluating the `date(,,)` function. The year 102 AD is a valid year so far as both PipeDream and Fireworkz are concerned so I would expect them to return 102 AD.

The best way of looking at the facility provided by PipeDream and Fireworkz for truncating the year is that it allows abbreviation of the entry into the formula line when there is no ambiguity. PipeDream and Fireworkz will expand your abbreviation before evaluation. Incidentally, neither PipeDream nor Fireworkz will accept an entry such as `24.1.(97+5)`; such an entry is interpreted as text. They will accept `24.1.97+5` – but the value returned is not five years but five days ahead.

The Missing Sunday

My dismissal of truncated dates as a user mistake rather than a design error should not be taken as a sign that I will excuse any fault in these packages.

See if you can find the value of the function `date(2000,12,31)` in either PipeDream or Fireworkz. If you have a different spreadsheet package (Lotus, Eureka, Schema, etc) you might like to try the equivalent function. The date returned in both PipeDream and Fireworkz is the first of the following year, 1st January 2001. Incidentally, if you enter `date(2000,12,30+1)` it returns the same date. The problem also exists for other century years which are leap years (viz every four hundred years). Try entering the function `date(2400,12,31)` and `date(1600,12,31)`; both PipeDream and Fireworkz have an aversion to storing the last day of the year.

Let's try another approach. Enter 31.12.2000 into the formula line. No sooner do you tap the <Return> button than the value in the formula line changes to 1.1.2001. This aversion PipeDream has when attempting to store the date 31.12.2000 was first reported to me by Ted Olley and Alex Bell early in 1993. Both of them discovered it when they were trying to solve a puzzle (set by that brilliant mathematician who used to work for Colton Software, Robert Macmillan) about the frequency with which Fridays fell on the 13th of

the month. I repeat the original version of the problem and its solution below.

Friday the 13th

“Every 400 years (since 1752) our calendar repeats itself. As an example of what I mean, in 1992, this year, Christmas day is on a Friday. Four hundred years into the future, 2392, it will be on Friday again. In fact, the calendar for 2392 will be an exact replica of the 1992 calendar. In the same way, 2393 will be a replica of 1993.

“During these 400 years, there will be $400 * 12 = 4800$ months and every one of them will have a 13th. If they were distributed so that each day of the week had an equal number then this would be about $4800/7 = 685.7$. I have been told that more of these 13ths fall on a Friday than any other day of the week so that a 13th is more likely to be a Friday than any other day. . . . Can you find the frequencies for all the days of the week?”

The solution (by many including Ted Olley and Alex Bell) is that during every 400 years there are 688 Fridays which fall on the 13th but only 684 Thursdays and Saturdays which do so. They found that a Sunday was missing; when they traced the missing Sunday they found it to be Sunday 31st December 2000.

The Time Format

The date is separated from the time by a single space. You can enter extra spaces if you wish but, as soon as you tap <Return> (or click on the green tick) the extra spaces will be removed.

For nearly all the date and time functions if you enter just part of the full date and time data then PipeDream and Fireworkz will use the information it has been given in a sensible way. If you enter just the time they will return just the time. If you enter a date without a time then they will display just the date. Only when you enter both will both be displayed.

If you enter times without leading zeros (eg 8:25:1) PipeDream and Fireworkz will add in the leading zeros to show 08:25:01 in the formula line as soon as you tap <Return>.

The [Date_Time] File

I have summarised the fourteen date and time functions of PipeDream Version 4.13 together with the four new functions of PipeDream Version 4.5 in the file [Date_Time] on the Archive monthly disc. Many of you who have Fireworkz also have PipeDream but, if you don't, then you can drag this file into Fireworkz and it will load. I'm sorry but you'll have to play around a lot with the layout and add new Date/Time Styles if you want to see what a PipeDream user will see right away.

The Functions Now and Today

I have already referred to (now). The only difference between (now) and (today) is that (today) does not return the time but only today's date. Neither PipeDream nor Fireworkz

have a function which returns just the time of day. My work around for this omission is to use the function `time(hour(now),minute(now),second(now))`.

The Functions `time()` and `date()`

The syntax of both these functions are similar. Each has three numerical arguments. In the case of time these are `time(hours,minutes,seconds)`. In the case of date the three numerical arguments are `date(year,month,day)`. As I mentioned earlier, if the year is entered as a two digit number (rather than four) PipeDream and Fireworkz will add the 19 in front of the two digits to ensure that the date is in the 20th century.

Concatenating Time and Date

You can add or subtract a time from a date. If a date appears without a time, PipeDream and Fireworkz assumes that the day has just started and sets the time to 00:00:00. Consequently you can enter into the formula line `24.1.1997+17:12:35` and the value returned will be `24.1.1997 17:12:35`; this is similar to the input but the + sign has been replaced by a single space. Similarly if the slot C4 contains a date and C5 contains a time you can enter into the formula line of a third slot `C4+C5` and you will get a date/time returned.

When you've done this try replacing the + with a – sign and you'll find that the time is subtracted from the date and that the correct answer is returned even though the subtraction takes you back a day through midnight.

The Functions Year, Month and Day – Hour, Minute and Second

The first three of these six functions accept a date as argument and return single numbers corresponding to the year, month number and day number. An example is `month(4.1.1997)`. It returns the month number as 1.

The second three functions operate similarly. For example `second(20:04:36)` returns the number of seconds, 36.

The Function Weekday

This function accepts as its argument a Date or Date/Time. It returns the day number of the week from 1 to 7 counting Sunday as 1. For example `weekday(28.7.32)` returns 5 because the 28th July 1932 (my birthday) was on a Thursday.

Returning for a moment to the missing Sunday, try `weekday(31.12.2000)`. It returns the number 1 (Sunday) which is correct. But look at what has happened in the formula line. The entry in the formula line has changed to `weekday(1.1.2001)`. Click again on the formula line and tap <Return>. The number changes to 2, Monday.

Try `weekday(30.12.2000+1)`. The 1 which has been added is the addition of one day to 30.12.2000. The correct answer is returned namely 1 for Sunday and this answer is stable.

The Function Monthdays

This function accepts as its argument a date or date/time. It returns the number of days in the current month. I use this this function to set up a series of dates exactly a calendar month apart (eg 6th Jan, 6th Feb, 6th Mar, etc), very useful for monthly standing orders.

The Functions Timevalue and Datevalue

The first of these functions accepts a string (ie text and not times) in time format as its argument; the second accepts a string in date or date/time format. The functions convert the strings to time, date or date/time values as appropriate.

As an example slot [Date_Time]B22 contains not a time but text. The text is 18:33:01. Slot [Date_Time]E22 contains timevalue(B22) and returns the time 18:33:01.

The Function Age – New in Version 4.5 of PipeDream

This function requires two dates (or date/times) to be entered. It returns a number such as 5.9 and 12.10. These look like and behave as decimal numbers but should never be used that way. The integer part is the number of years and the decimal part the number of months. As an example 12.10 should be interpreted as 12 years and 10 months not 12.1 years!

I recommend that you never use the age(.) function. Forget it exists. Neither PipeDream nor Fireworkz throw up an error if you (stupidly) try to execute some arithmetic on a slot containing the result of age(.). For example if you add 0.1 to an age such as 12.10 you will get the result of simple arithmetic 12.20. Don't use age(.).

The Function Dayname – New in Version 4.5 of PipeDream

In both Fireworkz and PipeDream 4.5 the function dayname(28.7.1932 8:25:00) returns the dayname as Thursday. "Thursday's child has far to go."

A work around for those with an earlier version of PipeDream is included later in the [DateTime] file.

The Function Monthname – New in Version 4.5 of PipeDream

In Fireworkz the function monthname(28.7.1932 8:25:00) returns July.

My mother once told me that my 'sun sign' and my 'rising sign' are both Leo. I've never had a full reading of my horoscope but I do get requests from readers who would like to use a spreadsheet to find where in the sky the sun, moon and all the planets were at the time of their birth. Any takers? Any volunteers to 'read' my chart? (I was born in Market Drayton, Shropshire, England – the local time was 8:25 am but I don't know whether British Summer Time was in operation that year or not.)

If you have version 4.5/06 of PipeDream the news is bad. This function fails to work since it returns one month later than it should. As an example monthname(28.7.1932) returns August (in error). Beware that entering a date or date/time for which the month is December will cause PipeDream to crash!

If you have a later version which 'works' then please let me know your version number.

A work around for PipeDream users (with or without V 4.5) is included later in the [Date_Time] file.

The Function Weeknumber – New in Version 4.5 of PipeDream

The version of Fireworkz which I have at the moment is version 1.25/08. It does not contain this function. Perhaps it is in a later version; if so then would you let me know?

In PipeDream this function returns the number of the week (1 to 53) starting with week 1 in January. I have not tested this function thoroughly so I am not sure of the algorithm. I suggest that before you use it in earnest for any particular year you enter the dates from the first week of January as well as the last week of December and check the answers. Here are a couple of examples: weeknumber(31.12.1996) returns 1; weeknumber(31.12.1998) returns 53. If any of you habitually use this function (on any spreadsheet) then perhaps you'll send me an example explaining how it is useful to you.

Date Arithmetic – Numbers Added to or Subtracted from Dates

Numbers added to or subtracted from dates or date/times are treated as a number of days. As an example type into the formula line 24.12.2000+6; the value returned is 30 Dec 2000. Another example: type in 28.7.1932 8:25+2; the value returned is 30 Jul 1932 08:25:00.

Date Arithmetic – Difference Between Two Dates

The function Age(.) returns the difference as years.months (see above). I don't like it and I recommend that you don't use it.

It is Tuesday, 28th January 1997 and I have just typed into the formula line (today-28.7.32) but without the brackets; the value returned is 23560. It would seem that I have been alive for over 23 thousand days. Both PipeDream and Fireworkz return the number of days between the two dates. Checking independently (with a BASIC program) I believe the answer 23560 to be correct.

The expression (now) returns a date/time so that (now-28.7.32) returns something which is rubbish. There is no error message.

Time Arithmetic – Numbers Added to or Subtracted from Times

Numbers added to or subtracted from times are treated as a number of seconds. For example 8:25:01+4 returns the time 08:25:05. By the way, note that whilst PipeDream and

Fireworkz suppress (remove) leading zeros from dates they both insert leading zeros into time format data entered into the formula line.

Time Arithmetic – Subtraction/Addition of Times from/to Date/Times.

If you subtract/add a time from/to a date/time then both PipeDream and Fireworkz will subtract/add the time and will return a new date/time. This arithmetic will cross the midnight barrier correctly.

As an example `3.1.2001 0:0:1-0:0:6` returns `2 Jan 2001 23:59 55`.

Time Arithmetic – Difference Between Two Times or Date/Times

Both Fireworkz and PipeDream return the number of seconds between the two times or date/times correctly only if the number of seconds is less than 24 hours worth. If the number of seconds exceeds the number in 24 hours (86400 seconds) then rubbish is returned without an error being reported.

I recommend that such time arithmetic is embodied within an `if(,,)` so that you generate your own error message if the difference is more than 86400 seconds. For example you might try `if(abs(date/time1-date/time2)<86400,date/time1-date/time2,“Error”)`. More elaborately I can write for you a custom function for successfully finding the difference between two date/times and returning the answer in days, hours, minutes and seconds. I haven't written such a custom function; would you like one?

Splitting a Date/Time into Date and Time

The function `date(year,month,day)` accepts as input year, month and day information (see above). Similarly the function `time(hour,minute,second)` accepts as input hour, minute and second (see above).

I believe that the best way of 'slicing up' a date/time into separate date and time is to use the functions `date(,,)` and `time(,,)` in conjunction with the functions `year()`, `month()`, `day()` and `hour()`, `minute()`, `second()`. It could be done with strings but I think that technique is a bit messy.

As an example suppose that the slot `[Date_Time]B54` contains the date/time `28.07.1932 8:25:00`. Then the function `(time(hour(B54),minute(B54),second(B54)))` will return `08:25:00` which, thereafter, can be treated as a time.

As I explained under the heading "The Functions Now and Today" the `time()` function can be used in conjunction with `(now)` to return just the time of day; this work around complements the function `(today)`.

Dayname and Monthname Without V 4.5

The final entries in the file `[Date_Time]` show how to use the PipeDream function

choose(list) can be used to find the dayname and monthname if you don't have PipeDream V 4.5. Until the bug in monthname() is fixed I recommend this work around because applying the V 4.5 function to a date for which the month is December will cause PipeDream to crash.

In the [Date_Time] file the list from which the monthname is chosen is held within a single slot.

The slot [Date_Time]C60 holds the array {"January","February",etc,etc,"December"}. This array is the list of monthnames from which the choice is made. The slot [Date_Time]E60 contains choose(month(B60),index(C60,1,1,12,1)) and it will return the monthname of the date or date/time entered into C60.

The Disc File [Date_Time]

If you would like a copy of the file [Date_Time] which is on the Archive monthly disc but you don't subscribe thereto then send me a blank formatted disc, return postage and a self addressed label and I'll put it on there for you.

If you are working on documents in PipeDream or Fireworkz which require these Date or Time functions then I suggest that you keep the file [Date_Time] handy so that you can check exactly how a date, time or date/time function works.

Other Spreadsheets

If you use Eureka or Schema (or the Pocket Book) then you could endear yourself to me by sending me a file similar to [Date_Time] but in Eureka or Schema format.

Finally

(a) Please send a disc, self addressed label and return postage if you want a problem solved; (b) My address is that of Abacus Training (see back inside cover); (c) Many thanks for all your letters.