Concepts in Mathematics
By David Alderoty © 2015

Chapter 8) Illustrating and Writing Mathematics with Microsoft Excel, SpreadsheetConverter, and Mathcad

Over 2,600 Words

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Microsoft Excel, SpreadsheetConverter, and Explaining and Demonstrating Mathematical Concepts

Note for this Section

This section deals with mathematical concepts, Microsoft Excel, and SpreadsheetConverter. The focus is mathematics that relate to the date and time functionality of Microsoft Excel. However, this chapter does **not** provide detailed instruction on how to use Microsoft Excel, or SpreadsheetConverter. If you want instruction on how to use the above software, see the web-based videos and articles at the end of this section.

Microsoft Excel, and SpreadsheetConverter

Most people are familiar with Microsoft Excel as a spreadsheet for addition, subtraction, and statistical calculations. However, Excel has a much greater functionality, and it can be used to create sophisticated calculation devices. These devices generally do not look like spreadsheets, and they can carry out complex sequences of mathematical calculation simultaneously. These

calculation devices are useful for **explaining and/or demonstrating mathematical concepts**.

In the following subsections, I present a complex mathematical concept, and demonstrate and explain it, with JavaScript software that I created with Microsoft Excel and SpreadsheetConverter.

When an Excel device is converted to HTML-JavaScript, with SpreadsheetConverter, it functions directly in a web browser, without Excel.

A Demonstration Device, in the Form of a Software-Based Calendar, to Illustrate a Mathematical Concept, Involving Repetitive Cycles

I created a software-based device*, in the form of a special* calendar, to demonstrate a mathematical concept that can be difficult to understand. **The idea here is if the reader does not understand the explanation, they can at least see that the mathematical concept functions in the form of software.** With this technique, it is necessary to display the related formulas directly on the software, along with explanations, which the reader may or may not understand in its entirety.

The mathematical concept that I explain with the software is useful for creating formulas that calculate dates based on specific days of the week. This is actually a general mathematical concept, but I am applying it to calculation devices created with

Microsoft Excel. See the following formulas I devised which function Excel.

Calculates dates that fall on Saturdays
=7*ROUNDDOWN((days/7),0)

Calculates dates that fall on Sundays
=7*ROUNDDOWN((days/7),0)+1

Calculates dates that fall on Mondays
=7*ROUNDDOWN((days/7),0)+2

Calculates dates that fall on Tuesdays
=7*ROUNDDOWN((days/7),0)+3

Calculates dates that fall on Wednesdays
=7*ROUNDDOWN((days/7),0)+4

Calculates dates that fall on Thursday
=7*ROUNDDOWN((days/7),0)+5

Calculates dates that fall on Fridays
=7*ROUNDDOWN((days/7),0)+6

The Above Formulas, and Related Mathematical Concept

The first formula listed above, =7*ROUNDDOWN((days/7),0) calculates dates with Saturday, when used in Microsoft Excel. With this formula, Excel converts a date, to a number of days from a predefined zero point. The predefined zero point in Microsoft Excel is on a Saturday. Then the days are divided by

seven, to convert them to weeks. The resulting number is rounded down to eliminate decimals. These decimals represent fractions of a week. Then the result is multiplied by seven, to convert it back from weeks to days. The days are converted back into a date, with Microsoft Excel format code. The result is always a Saturday, because, the predefined zero point in Microsoft Excel is on a Saturday, and the formula presents a date that is a precise number of weeks from the zero point. (This is actually common sense. For example, if today is Thursday, 10 weeks ago, it was also Thursday.)

The other formulas listed above, simply add a number to the above result. For example, =7*ROUNDDOWN((days/7),0)**+1,** always calculates dates that fall on a Sunday.

To fully understand the above concept examine the software linked to this page, and read the following sections on Microsoft Excel's date and time functionality.

HTML-JavaScript software
www.TechForText.com/Ma/C

Download link for Excel version
www.TechForText.com/Ma/CR.xlsx

You can download the JavaScript version, and two Excel versions in a zip folder, by clicking on the link below. Note: You must remove the JavaScript version, with the cut and paste function, from the zip folder, before using it. The JavaScript version is in a

separate folder with filename: **ClickOnIconWith-index.htm.**
One of the Excel versions has unlocked cells, for those who want to study the formulas that comprise the software. The filename is **UnlockedToStudyFormulas.xlsx.** Click on the following link to download the zip folder: www.TechForText.com/Ma/CR.zip

The Original Utility of the Above Formulas

I originally devised the above concept, and related formulas, when I encountered a problem while creating calendars, with Microsoft Excel. Specifically, conventional calendars, display Sundays on the extreme left. However, the calendars I initially created, would display the days, based on the start date that the user entered. For example, if the user entered a start date of May 1, Friday, 2015, Fridays would be displayed on the extreme left, instead of Sundays.

To solve the above problem, I configured the calendars to electronically divert the start date entered by the user, into the following formula: =7*ROUNDDOWN((days/7),0)+1. This formula would calculate a date that was a Sunday, which was usually a few days earlier than the start date the user entered. (If the user entered a start date that was **on** a Sunday, that date would automatically be used by the software.) The formula was placed in the extreme left. The remaining days on the calendar were calculated in proper sequence from the first Sunday, by adding an appropriate number. As a result, all seven days (from

Sunday to Saturday) would be automatically placed on the calendar in conventional style, by the software.

Repetitive Cycles, for Dates, and Time, and Microsoft Excel

Repetitive cycles, such as the seven days in the week, and the 24 hours in a day, have an endpoint, and a starting point. However, in many situations, especially with software, the endpoint and starting point of the cycle can be difficult to determine. For example, most software and programming languages, calculate time and dates from a fixed point in time, which might be over 100 years in the past. For example, Microsoft Excel uses Sunday, January 1, 1900, at 12 AM, as the starting point for their date and time cycle. The above is day one, which implies that time zero (or day zero) is Saturday, December 31, 1899. The formulas described above are based on this zero point. The proof for this concept is presented in the following subsection.

Determining DAY ONE, and DAY ZERO, with Microsoft Excel

If **1** is inserted into a cell, with the following format code: h:mm AM/PM, dddd, mmmm d, yyyy, Microsoft Excel displays the following time and date:

12:00 AM, Sunday, January 1, 1900

When **0** (zero) is inserted into a cell, with the format code presented above Excel displays:

12:00 AM, Saturday, January 0, 1900

Because there are no zeros on the calendar, from a mathematical perspective this can be defined as Saturday, December 31, 1899. The formulas that were previously presented, are based on the concept that day zero, or time zero, is defined by Microsoft Excel as a Saturday.

The Units of Time Used by Microsoft Excel's Internal Mechanism

The timing mechanism in Excel uses days, and fractions of the day, to calculate time. For example, today is Tuesday, May 19th 2015, but the internal mechanism of Microsoft Excel represents this says: 42,143. This is the number of days from the current date to time zero, which is Saturday, December 31, 1899. Similarly, the time is 1:29:53 PM, but Excel's internal mechanism represents this as 42,143.562422685200, which is days from time zero. The decimal actually represents the time of day, and the 42,143, represents the date.

Microsoft Excel's Functions for the Current Time and Date

Microsoft Excel has two functions (or formulas) for date and time, which are **=TODAY()** and **=NOW()**. The first formula **=TODAY()** can be used for obtaining the current date. The, number for the date presented in the previous subsection, 42,143, was obtained with this function, and format code to convert the date to a number.

The **=NOW()** function can be used to obtain the current time and/or date. The number for the time, presented in the previous subsection, 42,143.562422685200, was obtained with this formula, and related format code.

The numbers, produced by **=TODAY()** and **=NOW()** can be mathematically manipulated. For example, if you add one day to the first formula, as such: **=TODAY()+1** you obtain a formula for tomorrow. Similarly, a formula for yesterday can be created as follows: **=TODAY()-1.** You can create a formula for a different time zone by adding or subtracting 1/24 of a day to **=NOW()**. For example, **=NOW()+(3/24)** will display a time that is three hours greater than the your local time.

It is easy to make an error with the =NOW() function. For example, =NOW()**+3**, would not change the time, but it would change the date. This is because Microsoft Excel, only uses days and fractions of a day as units, for all date and time computations. Thus, one hour must be represented as **1/24**.

Excel's Computer Code to Display Date and Time, In Conventional Formats

As explained above, Microsoft Excel calculates dates and time, in days, and fractions of a day, such as 42,143.562422685200. Excel, and most programming languages use special code to convert date and time into units that humans can understand. Microsoft Excel, has many code sequences that are used for this

purpose, such as the following examples: (I am using following number of days from time zero all of the examples: 42,143.562422685200)

[$-F800]dddd, mmmm dd, yyyy
(Displays: Tuesday, May 19, 2015)

[$-409]mmmm d, yyyy;@
(Displays: May 19, 2015)

m/d/yyyy
(Displays: 5/19/2015)

[$-F400]h:mm:ss AM/PM
(Displays: 1:29:53 PM)

[$-409]h:mm AM/PM;@
(Display-example: 1:29 PM)

h:mm;@
(Display-example: 13:29)

I devised the following code sequences

h:mm:ss AM/PM, dddd, mmmm d, yyyy
(**Displays date and time**
1:29:53 PM, Tuesday, May 19, 2015)

h:mm:ss.000 AM/PM
(**Displays time to 1000th of a second**
1:29:53.320 PM)

Displaying Time and Dates in Terms of Days In Microsoft Excel, with Format Code

Any date or time that is displayed in Microsoft Excel can be displayed in terms of days, with any of the format codes listed below. (I am using the following time and date for all of the examples: 9:49:24 AM, Wednesday, May 20, 2015)

#,##0.000000000000
(Displays 42,144.409302777800)

#,##0
(Displays 42144)

0.000
(Displays 42144.409)

0
(Displays 42144)

I devised the following code
#,##0.00000000000 "Days"
(Displays 42,144.40930277780 Days)

For Supporting Information, Alternative Perspectives, and Additional Information, from Other Authors, on the Material Discussed in this Section See the following Websites

1) Google Videos: (www.google.com/videohp) Microsoft Excel and see also Microsoft Excel date and time functions.

2) YouTube Videos: (www.youtube.com) Microsoft Excel and see also Microsoft Excel date and time functions, and for SpreadsheetConverter see SpreadsheetConverter.

3) MASHPEDIA Videos (www.mashpedia.com) Microsoft Excel and see also Microsoft Excel date and time functions, and for SpreadsheetConverter see SpreadsheetConverter. **NOTE:** Mashpedia has a large number of videos on each webpage. To go from one webpage to another on Mashpedia, scroll to the **BOTTOM** of the webpage, and click on: **NEXT >>**

4) Microsoft Excel, Create a custom number format, **5)** Number Formats in Microsoft Excel, **6)** Microsoft Excel, Custom Number Format, **7)** Microsoft Excel, Date & Time Functions, **8)** Dates And Times In Excel, **9)** Understanding Text & Numeric Formats | Microsoft Excel, **10)** Custom Cell Formatting in Excel – Few Tips & Tricks, **11)** How to control and understand settings in the Format Cells dialog box in Excel, **12)** SpreadsheetConverter: Learn how to build live web pages from Excel spreadsheets, **13)** SpreadsheetConverter Downloads, **14)** SpreadsheetConverter: It's yours for free, for 30 days, **15)** Homepage: www.SpreadsheetConverter.com

Mathcad, versus Microsoft Excel, and Other Mathematics Software

A Note for this Section

In this section, I briefly discuss Mathcad and some of its advantages, over other types of math software. The material presented in this section is based on Mathcad 15. If you want information on newer versions of Mathcad, or instructions on how to use it, see the web-based videos and articles at the end of the section.

What is Mathcad?

Mathcad is mathematics software primarily created for engineers, but it is very useful for studying and practicing almost any type of mathematics. **The main advantage of Mathcad over Microsoft Excel, and other mathematics software is Mathcad uses conventional math notation.** To use Mathcad, you do **not** have to translate mathematical expressions into a special programming language. As a result of the above, documents created with Mathcad can be understood by anyone with a mathematical background.

Mathcad, versus Microsoft Excel, and Other Mathematics Software

To perform complex mathematics in Microsoft Excel, and many scientific and engineering mathematics programs, the user must learn how to translate mathematical expressions into a format that is unconventional. For example, the following integral was

solved with Mathcad, Microsoft Word's Mathematics add-in, and by Microsoft Excel.

Solved with Mathcad

$$\int_4^{12} x\,dx = 64$$

Solved with Microsoft mathematics add-in

$$\int_4^{12} x\,dx = 64$$

To solve the above problem with Microsoft Excel, you must translate the mathematical expression into the following format:

=((12)^2-(4)^2))/2

This format often results in errors, because it involves translating conventional mathematical expressions to an unconventional format. It is easier to solve the problem presented above manually, then to use Microsoft Excel, such as:

Manual solution

$$\int_4^{12} x\,dx = \frac{x^2}{2} = \frac{12^2 - 4^2}{2} = \frac{144 - 16}{2} = \frac{128}{2} = 64$$

However, =((12)^2-(4)^2))/2 will of course provide the same calculated result as $\int_4^{12} x\,dx =$ when inserted in a cell in an Excel worksheet. Nevertheless, the calculations will be quite confusing to most people, because of the unusual format required

by Microsoft Excel, and many other mathematics software packages.

Using Excel, and Many Other Mathematics Software Packages, is More Time-Consuming than using Mathcad

With Microsoft Excel, it is necessary to clearly label, and sometimes explain, each mathematical calculation. For example, if =((12)^2-(4)^2))/2 is inserted in an Excel worksheet, 64 will be displayed, without any notation indicating the nature of the calculation. The most practical solution in this case, is to create graphic of $\int_4^{12} x dx =$, and place it next to the cell with the formula =((12)^2-(4)^2))/2.

Carrying out complex mathematics with Microsoft Excel, and many other software packages, can be quite time-consuming because of the difficulties explained above. However, with Mathcad, these difficulties are eliminated, and most complex calculations can be completed in a matter of seconds.

Mathcad vs. Microsoft's Mathematics Add-in for Word

Microsoft's Mathematics Add-in for Word, is just as efficient as Mathcad, because it also uses standard mathematical notation. However, Mathcad can carry out complex calculations that cannot be done with Microsoft's Mathematics Add-in, such as the following examples:

(Note, Mathcad 15 uses an arrow,
instead of an equal sign for
Symbolic calculations.)

$$\int_a^b \sinh(x)\,dx \to \cosh(b) - \cosh(a)$$

$$\int_a^b \cosh(x)\,dx \to \sinh(b) - \sinh(a)$$

$$\int_a^b \tanh(x)\,dx \to \ln(\cosh(b)) - \ln(\cosh(a))$$

$$\int_0^c \int_0^b \int_0^a x \cdot y \cdot z\,dx\,dy\,dz \to \frac{a^2 \cdot b^2 \cdot c^2}{8}$$

$$\int_v^c \int_w^b \int_s^a x \cdot y \cdot z\,dx\,dy\,dz \to \frac{\left(a^2 - s^2\right) \cdot \left(b^2 - w^2\right) \cdot \left(c^2 - v^2\right)}{8}$$

$$\int_0^2 \int_0^2 x\,dx\,dy = 4$$

$$\int_1^3 \int_0^2 \int_2^4 x \cdot y \cdot z \, dx \, dy \, dz = 48$$

$$\int_1^3 \int_0^2 \int_2^4 x \cdot y \cdot z \, dx \, dy \, dz = 48$$

$$\int_4^{12} \sinh(x) \, dx = 81350.0874797381$$

Another advantage of Mathcad is it can perform a sequence of calculations simultaneously, based on a single input. See the following example:

Input in Radians

$Q := 0.785398163$

$\sin(Q) = 0.7071067809$

$\cos(Q) = 0.7071067815$

$\tan(Q) = 0.9999999992$

$\csc(Q) = 1.4142135629$

$\sec(Q) = 1.4142135618$

$\cot(Q) = 1.0000000008$

$\csc(Q) \cdot \sin(Q) = 1$

$\cot(Q) \cdot \tan(Q) = 1$

$\sec(Q) \cdot \cos(Q) = 1$

The above, is essentially a calculation device, and it carries out nine calculations simultaneously, when a value is entered for **Q:=**. A similar a device, can be created with Microsoft Excel, which may take up to one hour. The Mathcad device presented above took about five minutes to create. However, calculation devices created with Microsoft Excel, can be designed for high level of functionality and attractiveness. The Excel devices can be converted to HTML–JavaScript, and used on the web as an online calculator. This cannot be done with Mathcad.

For Supporting Information, Alternative Perspectives, and Additional Information, from Other Authors, on the Material Discussed in this Section
See the following Websites

1) Google Videos: (www.google.com/videohp) Mathcad, and see also Mathcad tutorial.

2) YouTube Videos: (www.youtube.com) Mathcad, and see also Mathcad tutorial.

3) MASHPEDIA Videos (www.mashpedia.com) Mathcad, and see also Mathcad tutorial. **NOTE:** Mashpedia has a large number of videos on each webpage. To go from one webpage to another on Mashpedia, scroll to the **BOTTOM** of the webpage, and click on: **NEXT >>**

4) All PTC Mathcad Tutorials, **5)** Mathcad Tutorial by Prof. Bern Kohler, The Ohio State University, **6)** An Introduction to

Mathcad © by Sidney Young, **7)** PTC Mathcad Express – Free Engineering Math Software, **8)** Mathcad, From Wikipedia, the free encyclopedia, **9)** PTC Mathcad community, **10)** Videos: Mathcad Academic Channel, **11)** MathCAD: Fundamental Instructions., **12)** Advantages of Mathcad for analysis

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