
Review of Scientific Workplace v4.0 - a mathematical tool reaches maturity

Michael McCabe
University of
Portsmouth

michael.mccabe@port.ac.uk



Supplier's contact details

Scientific Word Ltd
20 Bankpark Crescent
Tranent
East Lothian
EH33 1AS

T: 0845 766 0340;
Intl: +44 (1875) 616516
F: (01875) 613513

www.sciword.demon.co.uk

Scientific WorkPlace (SWP), Scientific Word (SW), Scientific Notebook (SN) and Scientific Viewer (SV) form a family of products for creating and reading mathematical documents. If you substitute the word 'Mathematical' for 'Scientific' in the product names you will immediately have a clearer idea about what they do. MacKichan Software may justify the names on the grounds that there are tools for converting physical units and menus of physical constants, but I can't imagine a non-mathematical scientist using the products. It's also worth looking at the price tag, before getting too hooked. I had to hunt around on the MacKichan Web site to find the current cost of SWP, SW and SN as \$650, \$450 and \$129 respectively for a single-user academic licence, with discounts for bulk-purchase. SV is a free browser allowing anyone to read and print documents produced by the other products.

Although Scientific WorkPlace Version 3.5 has been reviewed elsewhere (Pountney, 2002) it makes sense to provide an overview of the product, before considering its recent developments. SWP and SW both provide a front-end for LaTeX so that a professionally typeset mathematical document can be produced without knowing LaTeX. SWP and SN both provide integrated Maple 5.1 (Backhouse, 1998) and MuPAD Pro 2.0 (Wester, 1999) computer algebra, which does not require any knowledge of their syntax. SWP can be regarded as the full professional product for staff, especially if writing for publication is required. SN can be regarded as the cut-down student product with the mathematical word processing, Maple/Mupad computer algebra and use of an exam builder as in SWP, but no LaTeX typesetting.

One attraction of SN is that it can be used for the delivery of on-line courses. For example, in a paper presented at the recent International Conference on the Teaching of Mathematics, Francisco Alarcon (2002) described how he used WebCT for managing an interactive mathematics course and Scientific Notebook for providing the course material: "With a couple of hours tuition first year students are up-and-running doing mathematics interactively". The small file sizes means that they are downloaded quickly. Problems of displaying the mathematics are avoided and more importantly, the mathematics becomes interactive with the CAS capabilities of SN. Students purchase a little publicised 6-month SN licence for ~\$30 each, although the files can be browsed with SV for free.

It is appropriate to write my review of the SWP family of products using SWP itself, even though I am not using its powerful typesetting features significantly. After a straightforward installation on my Windows XP 2GHz 256MB Dell home PC, requiring on-line (or email) registration for it to become fully functional, I got cracking. A quick 20-minute "Learn the Basics" tour gave me the confidence that I could produce a decent document. I browsed through the hundreds of document shells available, ranging from those for mathematical and astronomical journals to those for student handouts, coursework and exam papers, but settled for a "Blank - Standard LaTeX Article". I can't complain that there was no Maths, Stats & OR Network Software Review template!

Trying to change fonts and font sizes as I would in an ordinary Word document brought me to an abrupt halt, until I found a Tag toolbar which allowed me to insert named text tags such as large, Large or LARGE into the document. When I highlighted some text and clicked on the Tag Italic button the text was italicised, but clicking again on the button, cf Word, did not

toggle the text back to Normal text. I had to click on the Tag Normal button instead. Little differences like this can niggle, until you get used to them. Another irritation was line spacing, which seemed to increase for no apparent reason, and I could only reduce it by roundabout means. Instead of centring text using a toolbar button, a tag is inserted via a menu item. No doubt all this is because a front-end to LaTeX is different from a word processor, but I don't see why it should not be made to look like a word processor. I decided to move on and try some equations instead.

I've been wondering why Mars will be at its closest to Earth for well over 6000 years on 27 August 2003. Consider the equation relating the (sidereal) orbital periods of Mars and Earth, $P=1.88$ years and $E=1$ year respectively, with the synodic period of Mars S , the time between close encounters or oppositions. The angular distance covered by Earth and Mars between oppositions must be the same:

Enter the equation: $\left(\frac{2\pi}{P}\right)S + 2\pi = \left(\frac{2\pi}{E}\right)S$

Simplify it $\frac{1}{P} + \frac{1}{S} = \frac{1}{E}$
(by hand as I could not find another way):

Use Solve Exact button and enter S to get: Solution is:

$$\left\{ \begin{array}{l} \emptyset \quad \text{if } \frac{1}{E} = \frac{1}{P} \\ \left\{ \frac{1}{-\frac{1}{P} + \frac{1}{E}} \right\} \quad \text{if } \frac{1}{E} \neq \frac{1}{P} \end{array} \right.$$

I'm puzzled already! Surely $\frac{1}{E} = \frac{1}{P} \Rightarrow S \rightarrow \infty$?

But at least I can pick out the required solution.

Use the Simplify button to get:

$$S = \left\{ \frac{1}{-\frac{1}{P} + \frac{1}{E}} \right\} = \left\{ \frac{1}{\frac{1}{E} - \frac{1}{P}} \right\}$$

Now use the Evaluate Numerically button:

$$\left[\frac{1}{\frac{1}{E} - \frac{1}{P}} \right]_{E=1} = \left[\frac{1}{1 - \frac{1}{P}} \right]$$

and again to find the synodic period of Mars:

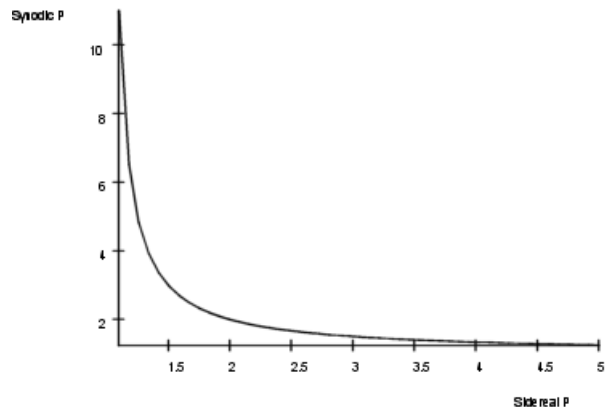
$$\left[\frac{1}{1 - \frac{1}{P}} \right]_{P=1.88} = 2.1364y = xd$$

The Unit Name button has been used to enter the physical quantities of years(y) and days(d)

Click on the Solve Exact button to get: Solution is: 780.3 days

$$S = \left[\frac{1}{1 - \frac{1}{P}} \right]$$

Click on the Plot 2D Rectangular Button:



The Synodic Period of an Exterior Planet Plotted as a Function of its Sidereal Period

As a first time user some experimentation was required to get what I wanted, but generally I had no problem with generating the mathematics. Finding the options I wanted for the graph was less easy and I could not find a way of making the marker for the location of Mars any larger, so it remains almost invisible. Fitting the labels and caption on the graph also proved to be equally troublesome.

At this stage I wondered which of the two computer algebra engines I was using by default. I expected Maple as the more common system, but discovered that I had actually been using MuPAD. I tried selecting the word 'MuPAD' in some text and hit the F1 key to get some context sensitive help. In fact, it simply took me to the Contents page and not to specific MuPAD help, so I went via Help - Search instead. On-line Help tells me that the output is much the same for both CAS and will be indicated by their respective icons if they differ. It was curious that there was no indication on the screen as to which engine I was using. I decided to switch to Maple and began to repeat my working:

Clicking the Simplify button this time gave me:

$$2\pi \frac{\frac{P}{P-1} + P}{P} = 2\pi \frac{P}{E(P-1)}$$

So I simplified it by hand again: $\frac{1}{P} + \frac{1}{S} = \frac{1}{E}$

Use Solve Exact button and enter S: No output was generated this time. Similar output followed, but I had the same problems with generating a satisfactory graph.

This time a lower limit of 1 did not give a meaningful plot and had to be changed to 1.1.

You may have noted that Mars is at opposition, ie close to Earth, every 780 days or 2 years 2 months, so if you want to know more about why the August 2003 encounter with Mars is the closest for over 6,000 years you will need to look elsewhere for a fuller explanation (McCabe, 2003).

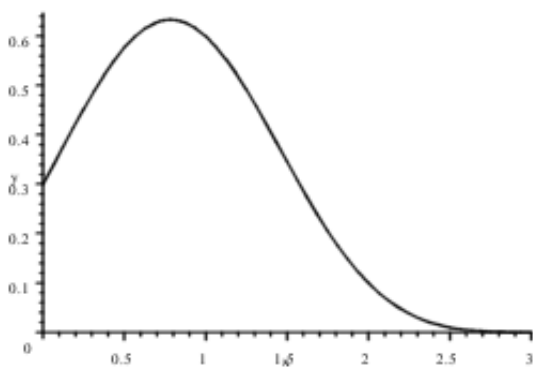
Let's try something else! If I ask my students a multiple response question in which they have to select n choices from M of which n are correct, the probability of choosing x correct is governed by the hypergeometric distribution. From now on I'm sticking with Maple:

$$\begin{aligned} \text{HypergeomDen}(x; M, n, n) &= \binom{n}{x} \frac{\binom{M-1.0n}{n-1.0x}}{\binom{M}{n}} \text{ (MapleEvaluate)} \\ &= \frac{1}{\binom{M}{n}} \binom{n}{x} \binom{M-1.0n}{n-1.0x} \text{ (MuPADEvaluate)} \end{aligned}$$

The 1.0 coefficients are irritating, but unimportant.

$$\begin{aligned} \text{HypergeomDen}(0; 5, 2, 2) &= 0.3 \\ \text{HypergeomDen}(1; 5, 2, 2) &= 0.6 \\ \text{HypergeomDen}(2; 5, 2, 2) &= 0.1 \end{aligned}$$

MuPAD would not plot $\text{HypergeomDen}(x; 5, 2, 2)$, but Maple would.



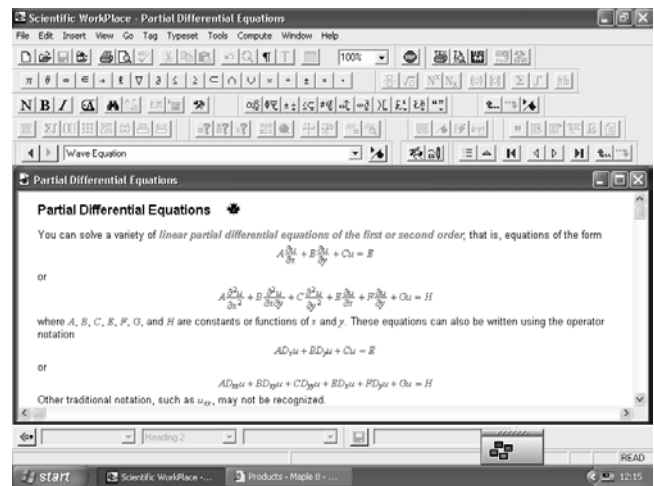
Continous Hypergeometric Probability Density

Unfortunately it was not straightforward to convert this into a histogram, which the manual told me had to be generated (rather tortuously) as a polygonal plot. More frustratingly, my earlier plot done with MuPAD, seemed to revert to a Maple plot and was no longer displayed correctly. It seemed as if I could not mix Maple and MuPAD plotting in the same document. Furthermore there was no obvious indication of which engine had generated which plot. The introduction of two engines seems to have caused me more confusion than help!

Just to emphasise my earlier point about scientists not being mathematicians, a professor in a scientific discipline recently calculated the three values shown

above as 0.31, 0.59 and 0.1 by using a Monte Carlo technique of entering random student choices and analysing the resulting distribution of answers. When I pointed out that the problem had a simple analytical solution, he commented that his mathematics was not up to it. It was easier for him to write a computer program!

I have previously used WinEdt as a poor man's front end to LaTeX. SWP is certainly a far more powerful, smoother and more friendly product. There are a large number of customisable toolbars, which can be displayed, although you quickly run out of screen space if you have all of them!



Customisable Toolbars in SWP4

Currently I work with Maple 6 and am about to upgrade to Maple 8. SWP4 uses Maple 5.1 and I suspect will always be out of step with the latest version. Wouldn't it be great if all these products could be synchronised? SWP will allow you to solve a range of ODEs and PDEs, but necessarily lags behind Maple V8 capabilities.

Established users of SWP will want to know about the new features in version 4. Many of them begin with words like *improved*, *enhanced*, *additional* or *more*, often an indicator that the changes are not fundamental, eg enhanced editing of tables and matrices. Others are rather specialised, eg Omega/Lambda international typesetting - great if you want to write your papers in Japanese! The choice of MuPAD or Maple algebra engine is heralded as a major new feature. I find it hard to believe that someone at MacKichan recognised that Maple had weaknesses and added the MuPAD capability specially to plug them! Far more likely, the addition was driven by commercial factors. As a Maple user I would use the Maple engine by default. Although you are supposed to be able to "take advantage of the strengths of each algebra system", I could see no clear

statement of when to use which one. Maybe you are just supposed to try the other if you are unhappy with the output you get, eg solve $y=ax^2+bx+c$,

MuPAD gives ... Solution is:

$$\left\{ \begin{array}{ll} \mathbb{R} & \text{if } a=0 \wedge b=0 \wedge -y=-c \\ \emptyset & \text{if } a=0 \wedge b=0 \wedge -y \neq -c \\ \left\{ -\frac{1}{b}(c-y) \right\} & \text{if } a=0 \wedge b \neq 0 \\ \left\{ \frac{1}{a} \left(-\frac{1}{2}b - \frac{1}{2}\sqrt{-4ac+4ay+b^2} \right), \frac{1}{a} \left(-\frac{1}{2}b + \frac{1}{2}\sqrt{-4ac+4ay+b^2} \right) \right\} & \text{if } a \neq 0 \end{array} \right.$$

Maple gives ... Solution is:

$$\left\{ x = \frac{1}{2a} \left(-b + \sqrt{b^2 + 4ay - 4ac} \right) \right\}, \left\{ x = \frac{1}{2a} \left(-b - \sqrt{b^2 + 4ay - 4ac} \right) \right\}$$

Take your pick! At least both agree that $e^{-i\pi} = -1$. You can, of course, look elsewhere for a critique of different computer algebra systems (Wester, 1999).

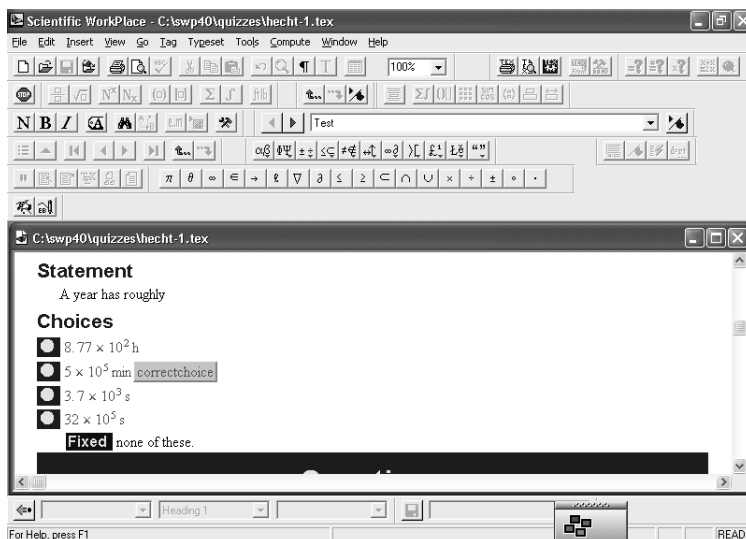
Twenty years ago I published a paper in the Monthly Notices of the Royal Astronomical Society (MNRAS). Today I can pick off a LaTeX document shell for the MNRAS from over 150 available. The document shells cover papers, articles, books and booklets, US theses, coursework, exams and handouts. The SWP manuals, as you would expect generated by SWP itself, are clear and well-written. Besides *Getting Started*, *Doing Mathematics* and *Creating Documents*, there are two new ones for SWP4 covering typesetting (printed) and document shells (gallery on CD). There is no manual provided for the Exam Builder, which is supported instead by on-line help. New to Exam Builder in version 4.0 is the ability to deliver on local networks and easier

on-line use.

There is above all one new feature, which stands out as a significant addition to SWP. That is the ability to export LaTeX documents to HTML, with mathematics exported as graphics or as MathML. This document looked fine with graphics export when viewed in IE6, but needless to say, there were a huge number of graphics files. The program supports MathML for IE5.5 or higher running under TeXexplorer Pro, though I did not test this out. The third alternative is to use the free Scientific Viewer. Since the .tex files created are small they can be expected to download quickly.

Overall I was impressed by SWP, even though I only scratched its surface. If I simply wanted computer algebra, I'd personally stick with Maple, having got used to its quirky syntax. On the other hand, I shall certainly consider using SN with students, if only to eliminate all their troublesome Maple syntax errors. If it's mathematical word processing and typesetting, as well as computer algebra that you want, then SWP4 is an invaluable tool.

Finally, I used File - Preview/Print to create a printed copy of this review for myself as it appeared on the screen. This worked fine. Unfortunately, the alternative Typeset - Preview/Print which should have given me "professional quality LaTeX printing" left me with nothing but gobbledygook messages including: "No swp000.aux. LaTeX Error: There's no line here to end. See the LaTeX manual for explanation". For this reason I was unable to try out the typesetting features. Scientific WorkPlace is not foolproof!



Sample Question with Random Parameters

References

- [1] Alarcon F, *Teaching an Interactive Mathematics Course for Liberal Studies over the Web*, Proceedings of the 2nd International Conference on the Teaching of Mathematics, Univ of Crete, Wiley (2002)
- [2] Backhouse N, *Review of Maple V Release 5*, Maths&Stats (Aug 1998) <http://www.bham.ac.uk/ctimath/reviews/aug98/maple.pdf>
- [3] MacKichan Software Inc., <http://www.mackichan.com>
- [4] McCabe E M, *Close Encounters of a Martian Kind, Three Eclipses and a Transit*, Mathematics Today, (Dec 2002)
- [5] Pountney D, *Scientific WorkPlace for Windows Version 3.5 - A Review*, International Journal of Computer Algebra in Mathematics Education (2002)
- [6] Wester M J, *A Critique of the Mathematical Abilities of CA Systems*, Computer Algebra Systems: A Practical Guide (Jan 99) http://math.unm.edu/~wester/cas_review.html
- [7] WinEdT (An Alternative LaTeX Front-End), <http://www.winedt.com/>

Footnote

Christopher Mabb, from Scientific Word Ltd, has subsequently corrected my "errors" and I have been able to print a properly typeset LaTeX document to my satisfaction. Whilst my errors relate largely to the way in which LaTeX tags information, I feel strongly that it is the task of software developers to shield the less experienced user from LaTeX. That is surely one of the purposes of the software and Scientific Word should behave in a similar way to MS Word. To put it another way, usability ought not be inversely proportional to functionality. Christopher Mabb suggests that: "SWP is like being given a Ferrari after you have been used to a Metro". Does anyone have a Ferrari that I can test drive? I'd be fascinated to see if I stalled it at my first attempt!

He also suggests that I could have got a head start by using a "Standard LaTeXArticle" shell rather than a "Blank - Standard LaTeXArticle" shell. With hindsight this is what I should have done. Another user error?

He also notes that educational prices for the UK can be found at <http://www.sciword.demon.co.uk/v4-0.htm>: £395 for SWP, £295 for SW and £80 for SN - still a lot cheaper than a Ferrari!

Editor's Note: Although Michael used SWP to write this review, we had to convert it to Rich Text Format (RTF) for the purpose of publication here. The online version will be a Portable Document Format (PDF) version of his original SWP file.

Supplier Comments from Christopher Mabb, Scientific Word Ltd, UK

We accept Michael's kind acknowledgment of our earlier comments on the draft copy. Please note that we're now shipping the latest v4.1. We'd like to invite all prospective users to take us up on our offer of a free 30-day demo of any of the three programs: Scientific Word (WYSIWYG LaTeX), Scientific WorkPlace (WYSIWYG LaTeX plus Maple/MuPAD) and Scientific Notebook (WYSIWYG Maple/MuPAD). That's an offer Ferrari don't make! And when you buy, we ship within 24 hours and give a month's free credit! Professional training is also available to those of our customers who don't just want to 'jump straight in and drive'. More info at: <http://www.sciword.demon.co.uk>