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# Review of Mathcad Professional 2000

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Mathcad is a package for creating technical documents which include mathematics and graphs. Earlier versions have been reviewed in several issues of the CTI Mathematics and Statistics Newsletter[1–4]. For a general overview of Mathcad I refer the reader to these reviews, and also to the homepage of Adept Scientific[5], who supply the package. I shall instead concentrate mainly on the new features of Mathcad 2000.

Installation from the CDROM was straightforward, and no problems were encountered. A Reference Manual (180 pp) and a User Guide (335 pp) are also provided. These seem well written and useful, but perhaps make rather heavy reading to the Mathcad novice; the average student will almost certainly require a gentle guide.

The standard Mathcad help is also very thorough, but again not easy for the beginner. Nevertheless, the Help pull-down menu includes a 'Resource Center'. This has been a useful feature of the last few versions of Mathcad, but I find the current version a big improvement over the previous versions. It provides comprehensive overviews and tutorials on the use of the package. I would certainly recommend its use to students rather than the traditional manuals and help facilities.

## ***New Functions***

Mathcad2000 includes a range of new functions. Unlike many existing functions, which are only of interest to the specialist, the new functions include several that are important in many undergraduate course, and which perhaps have been a sad omission in the past. These fall into three areas:

1) Finance functions. These include functions to calculate future value, present value, net present value and effective rate of interest. At last here is something to stimulate the business oriented student, who might otherwise regard Mathcad as more of an engineering tool than a general mathematical modelling tool. Interestingly the QuickSheets in Mathcad 8 Pro also include topics such as calculating future value and net present value, but these explain how to define the functions – Mathcad 8 does not provide them pre-defined. For the teacher, this means being able to concentrate on exploring the concepts separately from the formulae for calculating the values.

2) Curve fitting functions. These provide a wide range of functions for fitting lines and curves to sets of data points. In addition to least squares linear regression, there is median-median linear regression. Following the Resource Center to access the Data Analysis QuickSheets on this latter function, not only provided information about how to use the function, but also some brief guidance on when to use it together with a comparison with the more usual least squares function. Thus the Resource Center can be used as a learning aid in itself.

In addition to the line fitting functions, there are also a range curve fitting functions including exponential, logarithmic, power, logistic and sine functions. These are all based upon a general fitting function, although this was available in version 8 and is not of itself new for Mathcad2000. Again, version 8 provides advice on defining the curve fitting functions, whereas Mathcad has them pre-defined. From a purely educational point of view, it might be argued that it would be better to have the student use the genfit function in order to better understand the mathematical technique. But for modelling exercises, there

is something to be said for having the functions pre-defined. As ever, it is up to the teacher to decide what is most appropriate for the learning objectives.

3) Boolean logical operators. Boolean operators and, or, not and exclusive or are available, though little help is provided. Although truth values are represented as 1s and 0s, the symbols  $\neg$ ,  $\wedge$  and  $\vee$  are used instead of the more usual symbols of Boolean logic. Personally I would prefer to see a consistent notation, perhaps by representing truth values as T and F. This is no doubt a useful addition to Mathcad, but I feel there is room for much improvement.

4) Differential equations can now be defined within a *solve block* along with initial conditions; the solution can be obtained by using a new built-in function *odesolve* instead of the usual solve function. An option of fixed or adaptive solution is provided.

### Document Appearance

Mathcad serves two purposes: it is a system for preparing technical documents; and it is also a system for doing mathematics. In the past, much of the development in the package has been aimed at extending its functionality while many aspects of appearance have remained unchanged since version 1. Hence the notation is not what would be expected in a conventional mathematical document. For example, the assignment operator  $:=$  (familiar from some programming languages) is used where an equals sign  $=$  would normally be expected in a document. Multiplication has been a particular weakness: no multiplication sign, no implicit multiplication and a very poor dot notation. Partial derivatives have always been displayed as total derivatives. This latest version of Mathcad overcomes

these problems by allowing the user to alter the appearance of these (and other) operators. This is a very welcome and long overdue improvement. Figure 1 demonstrates some of these modifications. But note that squared trigonometric functions such as  $\cos^2 x$  still cannot be displayed naturally.

A Mathcad document comprises a number of rectangular regions, each of which may contain text, some mathematics or a plot. In Figure 1 these are displayed as white areas. Editing in Mathcad can be done at two levels: the regions can be moved around the page; and the contents of a region can be altered. To help with the layout of regions on a page, it is now possible to display a ruler (see Figure 1). Tab stops can be set and displayed as vertical lines. These guidelines assist with lining up the regions on the page. Furthermore the tab key used to move across the page to the next tab stop provided the cursor is not currently within a region. (When the cursor falls within a region, editing is now of that region rather than of the layout of regions on the page.) This seems to be quite a useful extension to Mathcad's editing facilities, though hardly an essential one. Rulers and tab stops can also be set up when editing a text region: this makes the text region seem more like the window of a word processor.

### Creating Electronic Books

Electronic books have long been a feature of Mathcad. An electronic book comprises a collection of Mathcad linked documents. The excellent Resource Center is an example of such a book. Mathcad2000 now provides a range of tools for and information on creating new electronic notebooks within Mathcad itself. This is certainly a feature I shall be wanting to explore in developing new learning materials.

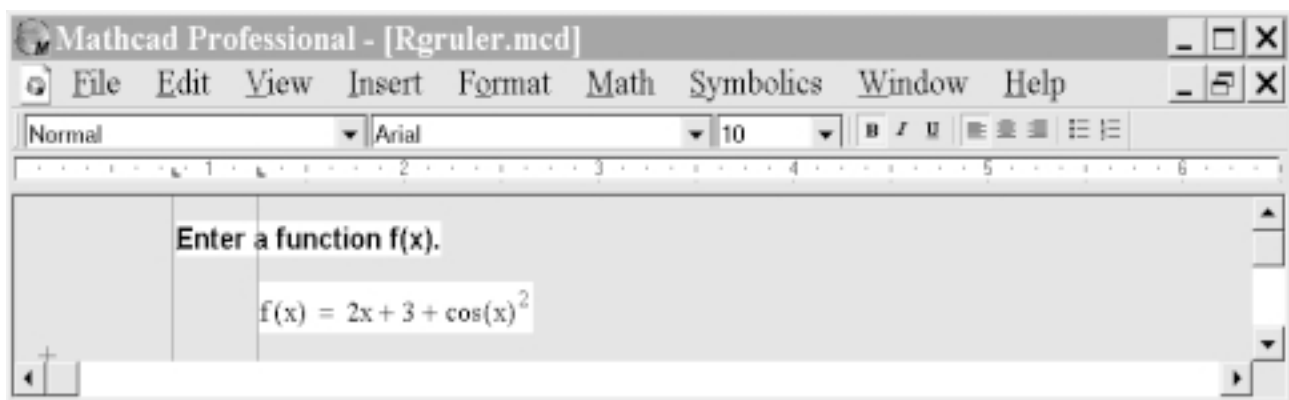


Figure 1: A simple example of a Mathcad2000 document.

### **Spelling**

A new feature which does not appear in the official list is the option to specify the English spelling to be adopted. Unlike most other products, this includes two varieties of British spelling: -ize and -ise. For people, like me, who prefer to use the -ize spelling, this is a particularly welcome feature.

### **Other New Features and Improvements**

There are many other developments in Mathcad2000 which are not discussed here. Perhaps most noticeable of these is the improved interoperability with Excel. From Excel it is now possible to incorporate a wide range of the advanced mathematical and graphical capabilities of Mathcad.

### **Conclusion**

Mathcad is certainly a package which warrants close inspection, whether you are a current user of an older version, have never considered Mathcad, or have looked at an earlier version of Mathcad: many weaknesses of earlier versions have now been remedied. For myself, I have just taken delivery of a number of copies of

Mathcad2000; but I do not see the need to abandon earlier versions entirely, and will continue to use these earlier versions with some of my classes. I am looking forward to developing teaching materials based on the electronic book idea.

### **References**

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- [5] [www.adeptscience.co.uk](http://www.adeptscience.co.uk)