
Review of DERIVE Version 5.00

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Version 5.00 is the latest version of the now well established Derive computer algebra system. Derive had its roots in the Mu-Math program, first released in 1979, with the first version of Derive, produced by Al Rich and David Stoutemyer at the Soft Warehouse, appearing in 1988. Derive 1.00 was a MS-DOS program able to run on a basic IBM-PC compatible computer with 8088 processor, 512 kbyte of RAM and one 360kb floppy disc drive. It was contemporary with the first appearance of Mathematica (initially available on Macintosh computers only!) and preceded the first MS-DOS version of Maple. At that time University undergraduate computer laboratories were, for reasons of cost, not generally equipped with computers capable of running Mathematica or Maple so, in its early years, Derive offered the only practical route for those of us who wanted to teach our students the use of computer algebra systems. Not that using Derive was any great disadvantage – it offered a simple and fairly intuitive user interface and adequate capability for most undergraduate uses. At the time it seemed a small miracle to have a computer algebra system able to run on machines of such modest specification! Derive Version 5.00 still runs on any computer which has the minimal capability of running Windows95, Windows98 or WindowsNT with a CD-ROM drive and 3Mbytes free space on its hard drive – still pretty minimal beside the average bloated software package of the 21st century!

Version 2.01 of Derive was reviewed by Mike Beilby in *Maths & Stats* Vol 2, No 1 (1991), version 3.00 was reviewed in Vol 6, No 4 (1995) and version 4.00, the first appearance of Derive for Windows was reviewed in Vol 8, No 2 (1997). Over the years the capability of Derive has developed steadily with the addition of new functions and some programmability features. From an early stage Soft Warehouse Inc built up a close working relationship with Texas Instruments and inbuilt versions of Derive have appeared in various TI calculators. In August 1999, between the appearance of Derive for Windows 4 and this latest version of Derive, Soft Warehouse Inc was taken over by Texas Instruments. Nonetheless, with the original authors of Derive still working with Texas Instruments, Version 5.00 very strongly shows its ancestry as a direct development from Version 4.00.

The main capabilities and menu structures of Derive 5.00 will be perfectly familiar to users of earlier versions. In short Derive styles itself “The Mathematical Assistant for Your PC” and performs numerical and symbolic calculations, algebra, trigonometry, calculus and graph plotting in 2 and 3 dimensions. Compared with previous versions of Derive, the principal areas of enhancement in Derive 5.00 are in the user interface in both algebra and plot windows, in the programmability of Derive and the provision of some additional mathematical functions and operations. Derive 5.00 has added some new features and brought the user interface more fully into line with the WindowsNT model. In Figure 1 some of the obvious differences in user interface are apparent. Below the main algebra window, an expression entry line and two toolbars, one containing Greek characters and the other offering mathematical characters, have been introduced. These new features can easily be suppressed if a user prefers but the authors have obviously given a lot of thought to making the package accessible and easy to use for those less familiar with the vast array of characters and symbols routinely used in mathematics - there was, on the mailbase ‘derive-news’ mailing list, some lively discussion of these new features during the design process. The expression entry line also provides good diagnostic information when the line entered contains syntax errors. In figure 1 we see that the INT function has been entered in the style familiar to Maple users rather than the correct Derive

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style with the result that Derive has found some unrecognised full stops which it identifies with a flashing cursor and an error message. Figure 1 has also been used to show another new feature of Derive 5, the multi-line, indented, formatted display of some types of expression, particularly IF statements and PROG statements (see below). Another new feature, the Derive worksheet, is a new format for saving work in which graphs, comments and other OLE objects may be mixed with Derive expressions and computations (this format is very similar to the 'Maple worksheet' format offered by Maple).

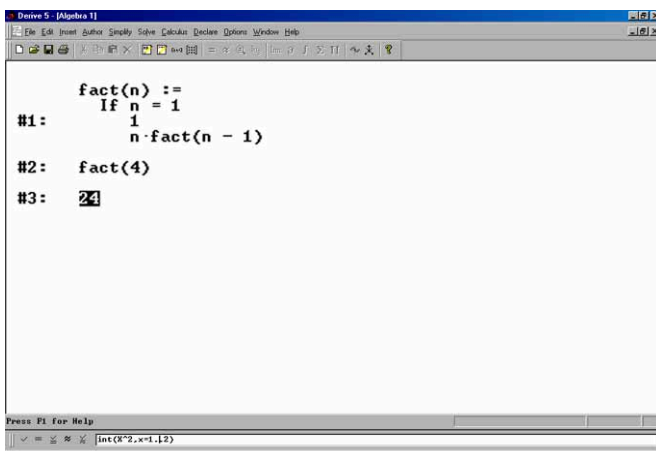


Figure 1: The Derive 5.00 main window

The graphical features of Derive have been enhanced quite considerably. The most significant changes are the ability to save graphical images as JPEG, TIFF, TARGA or DIB files and the introduction of the rotating and zooming of 3D plots. 3D plots can now be produced in a fully shaded format instead of the quasi wire frame format of earlier versions of Derive and can be rotated and zoomed very easily using a well thought out set of user interface buttons. The rotation about one axis can be made automatic and continuous so that an all round view can be seen dynamically. This rotating of the plots is also rather reminiscent of the similar feature in Maple but this reviewer found the user interface of this feature in Derive to be slightly easier to use than Maple's. Figure 2 shows a 3D plot of the function $z = x^3 + 2x^2 - y^2$ from two different angles. It is, of course, very difficult, using only static illustrations, to do justice to a feature which relies heavily on dynamic movement.

It is probably in the programming sphere that the most far-reaching enhancements have been made. Derive has always provided somewhat less sophisticated programmability features than Maple and Mathematica. From Derive 2 onwards there has been an ITERATE function. Subsequent development has seen the introduction of an IF function, and recursive function definition has become possible. The programming model which has always been encouraged by Derive's programmability features is that of 'functional programming' rather than the more common 'procedural programming' paradigm. Of course some believe that procedural programming is not the best model of programming, particularly for mathematical applications – for instance the APL and J languages are almost entirely functional in nature and are highly mathematically oriented. Nevertheless, functional programming is a distinct skill and often presents difficulties for those brought up on procedural programming. In Derive 5 the introduction of the PROG and LOOP functions with their associated EXIT and RETURN statements makes a more procedural style of programming possible. It would not be easy to construct large procedural programs but the authors would probably argue (rightly in the reviewer's opinion) that Derive is not intended for that purpose. But small procedural programs can now be embedded in function definitions and used within the overall functional programming model encouraged by Derive. This vastly increases the range of what is possible when programming with Derive 5. There are also new MAP and MAP_LIST functions which map a function onto a list or set of

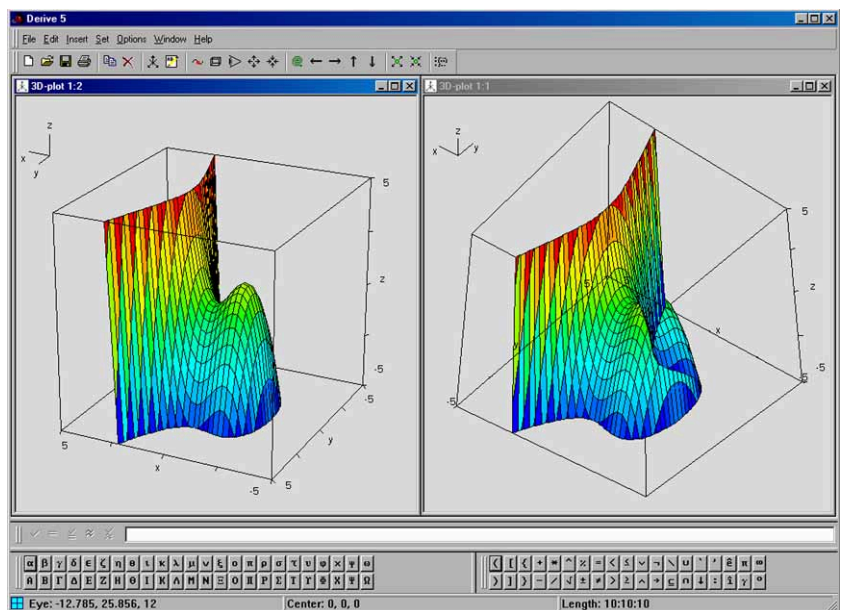


Figure 2: Two views of the surface $x^3 + 2x^2 - y^2$

expressions and a SUBST function has been introduced so that substitutions can now be programmed. Derive users who have tried creative programming with previous versions of Derive will probably appreciate how much this feature was missed in the past and how significant is their introduction now.

By contrast to the significant improvements in other areas, the enhancements to the mathematical capabilities of the package are less obvious. One of the major developments is that Derive can now solve systems of non-linear polynomial equations using the Groebner basis algorithm. The reviewer tested this out with a few examples slightly more complex than those given in the manual and the help file. The examples chosen were solved by Maple in a few seconds and it was rather disappointing initially to find that Derive produced no solution after three or four minutes. Some email correspondence with one of the authors of the package pointed out that, provided one sought approximate (numerical) solutions rather than exact solutions, Derive could indeed solve the test problems. The explanation lay in the appreciation that what the Groebner basis algorithm actually does is reduce the coupled non-linear equations to an equivalent set of equations in which one equation is a higher order polynomial involving only one of the variables - Derive was failing to find the exact roots in the test examples and needed to be told to seek approximate roots instead! Given that many users of the package will probably be unfamiliar with the details of the Groebner algorithm, the manual or the help file could usefully provide a little more explanation and some hints on getting the best out of this capability. Other enhancements of the mathematical engine seem to represent less fundamental, but nonetheless useful, improvements around the margins of its capabilities.

The package is supplied with a 44 page Reference Manual and a 277 page Introduction to Derive 5 Manual. The Introduction to Derive Manual is very much in the tutorial style designed to be read linearly, not to be dipped into to find out how to use particular features. The manual is clearly written and satisfactorily covers the basics – once a user has read it, preferably whilst sitting at the computer trying things out, they should understand enough to use Derive in anger. Derive is also supported by a Web site at <http://www.derive-europe.com>. The site has a variety of useful information, FAQs and downloadable material. Previous versions of Derive have always had regular updates and bug fixes. At the time of writing this review patches were already available to upgrade Derive 5.00 to Derive 5.02.

In summary, Derive 5 has added some very worthwhile new features to Derive particularly in further improving the already very good user interface and enhancing Derive's programmability. It is obvious that the authors have thought very carefully about the user interface and designed it to make the package more accessible to the student and the inexperienced user. Whilst Derive does not have the same ultimate power and breadth of features as Maple or Mathematica it is a more suitable package for the casual or occasional user and probably for many professional users whose needs are for standard rather than esoteric mathematical features. In many ways Derive's orientation towards an intuitive interface and a rich but focussed feature set can be seen as a strength rather than a limitation. Allied with excellent value for money this makes Derive a strong contender in appropriate sectors of the educational, scientific and technological markets.

DERIVE Version 5.00, written by Al Rich, Theresa Shelby, David Stoutemyer with contributions by others. Price for a single user, academic licence £49.00 or £29.00 (plus VAT) upgrade from Derive 4; site licence terms are also available.

Response from Albert Rich (co-author of Derive) and Chartwell-Yorke

"The recently released Derive 5.02 fixes several problems with the non-linear polynomial equation solver. A free update to version 5.02 (for existing version 5 users) can be downloaded from the Derive website at www.derive.com" - Albert Rich.

Details of the mathematical, programming and interface enhancements in Derive 5 (plus a free 30-day trial and the first two chapters of the manual) are at <http://www.chartwellyorke.com/dfwwin.html>

Derive 5's ease of use and power let students concentrate on mathematics rather than struggling with interfaces. Universities using Derive have achieved impressive results. We encourage readers to try it for themselves.

Free inspection copies of Derive textbooks and demo CD-ROMS are available in the UK from Chartwell-Yorke.