



Chapter 1

Welcome to Mathcad

This chapter introduces you to the Mathcad environment and provides a broad overview of product features.

What is Mathcad?

Mathcad's design and interface.

Mathcad editions and feature overview

Feature list, and differences between Professional, Standard, and Academic editions.

New in Mathcad 8

Feature highlights for upgraders.

Technical support

How to get assistance if you need it.

What is Mathcad?

Mathcad is the industry standard calculation software for technical professionals, educators, and college students. Mathcad is as versatile and powerful as programming languages, yet it's as easy to learn as a spreadsheet. Plus, it is fully wired to take advantage of the Internet and other applications you use every day.

Mathcad lets you type equations as you're used to seeing them, expanded fully on your screen. In a programming language, equations look something like this:

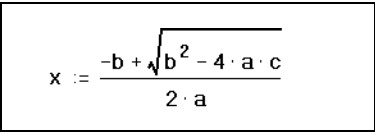
$$x = (-B + \text{SQRT}(B**2 - 4*A*C)) / (2*A)$$

In a spreadsheet, equations go into cells looking something like this:

$$+ (B1 + \text{SQRT}(B1*B1 - 4*A1*C1)) / (2*A1)$$

And that's assuming you can see them. Usually all you see is a number.

In Mathcad, the same equation looks the way you might see it on a blackboard or in a reference book. And there is no difficult syntax to learn; you simply point and click and your equations appear:


$$x := \frac{-b + \sqrt{b^2 - 4 \cdot a \cdot c}}{2 \cdot a}$$

But Mathcad equations do much more than look good. You can use them to solve just about any math problem you can think of, symbolically or numerically. You can place text anywhere around them to document your work. You can show how they look with Mathcad's two- and three-dimensional plots. You can even illustrate your work with graphics taken from another Windows application. Plus, Mathcad takes full advantage of Microsoft's OLE 2 object linking and embedding standard to work with other applications, supporting drag and drop and in-place activation as both client and server.

Mathcad comes with its own on-line reference system called the Resource Center. It gives you access to many useful formulas, data values, reference material, and diagrams at the click of a button.

Mathcad simplifies and streamlines documentation of the engineering process, critical to communicating and to meeting business and quality assurance standards. By combining equations, text, and graphics in a single worksheet, Mathcad makes it easy to keep track of the most complex calculations. The document formatting and preparation features make it even easier, and by printing the worksheet exactly as it appears on the screen, Mathcad lets you make a permanent and accurate record of your work.

Mathcad editions and feature overview

Mathcad 8 is available in several editions:

- **Mathcad Professional edition** is the industry standard for applied math in technical fields, delivering complete calculation and reporting functionality for professional results. With the most complete set of features available, the Professional edition delivers an integrated environment for performing, sharing, and communicating technical work.
- **Mathcad Professional Academic edition** is the software package of choice for students and their instructors who want access to the same tool that the professionals use. The Academic edition provides all the power and features of the Professional edition along with specialized electronic content and resources—all at a special educational price.
- **Mathcad Standard edition** is the ideal application for everyday technical calculations, well suited for quick and easy use when pencil and paper, calculators, and spreadsheets aren't up to the job.

All features described below are available in the Professional and Academic editions of Mathcad. Mathcad Standard includes all features except those labeled **Pro**.

The best in calculating power

- Solve linear and nonlinear systems of equations with hundreds of variables and constraints
- Create and manipulate vectors and matrices
- Pro** ■ Perform advanced linear algebra computations, including Cholesky, QR, LU and SV decomposition problems
- Apply Laplace, z, Fourier integral, and fast Fourier transforms and their inverses
- Pro** ■ Apply wavelet transform and inverse
- Pro** ■ Apply advanced techniques to manipulate arrays of arrays
- Find the inverse, transpose, and determinant of a matrix, and eigenvalues and eigenvectors
- Pro** ■ Solve ordinary differential equations and systems of differential equations (available also in Mathcad Standard), partial differential equations, and boundary value problems
- Find derivatives and perform integration using a variety of built-in numerical and symbolic methods
- Expand, factor, and simplify expressions algebraically
- Pro** ■ Evaluate Hermite, Jacobi, Laguerre, Legendre, and Chebyshev classes of polynomials

- Pro**
- Compute the values of Airy, Bessel Kelvin, spherical Bessel, and other special functions
 - Draw population and sample statistics from large data sets
 - Apply statistical functions to support hypothesis testing and data analysis
 - Perform data smoothing, regression analyses, and curve-fitting on your data sets
 - Handle real, imaginary, and complex numbers, plus dimensional values
 - Use Live Symbolics to perform symbolic mathematics on the fly
 - Get results in decimal, binary, octal, or hexadecimal format

New analytical power

- Find the optimal solution to a problem, with or without constraints
 - Solve systems of equations using powerful new linear programming functionality
 - Solve problems with hundreds of variables and constraints
- Pro**
- Solve systems of equations using powerful quadratic programming functionality in the Expert Solver for Mathcad 8 Professional, available for sale separately

New IntelliMath

- Speed through common tasks with the help of IntelliMath, which automates routine operations
- Let Mathcad's AutoSelect feature analyze your problem and select the best-solution algorithm
- Optimize your expressions, and let Mathcad's built-in numeric and symbolic processors work together to find the best solution to your problem
- Watch as Mathcad automatically tracks and converts your units as you work, using the complete SI unit system, as well as MKS, CGS, and U.S. customary units

Visual, easy-to-use interface

- Work with expressions visually
- Write equations and expressions using real math notation
- Perform calculations as you would on paper, but with 100% accuracy
- Apply calculations immediately and across multiple data sets without rework
- Illustrate, arrange, and annotate your calculations in ways beyond what's possible in spreadsheets
- Record and document your work for subsequent updating and referencing

Powerful functional programming

- Pro** ■ Create your own functions quickly using Mathcad's programming operators
- Pro** ■ Use looping, recursion, conditional branching, and other procedural operators for building functional programs
- Pro** ■ Define complex data structures, nested arrays, string variables, and more
- Pro** ■ Implement run-time error handling with the On Error statement

Tight integration with your other applications

- Move data from all the most common applications in and out of Mathcad, quickly and easily
- Launch and edit Mathcad from worksheets directly within word processors, spreadsheets, and other applications
- Access the graphing capabilities of MathSoft's Axum or S-PLUS within your Mathcad worksheets
- Pro** ■ Use wizards to integrate data and computations into your Mathcad worksheets from Excel, S-PLUS, and MATLAB
- Pro** ■ Drive your CAD drawings from Mathcad and automatically verify them against specifications
- Pro** ■ Embed, link, and automate any OLE 2-compliant application in Mathcad using VBScript or JScript
- Use OLE Automation to develop complete solutions incorporating Mathcad computations

Complete extensibility

- Pro** ■ Set up your own function libraries
- Pro** ■ Add functions written in the C or C++ programming language for use in Mathcad
- Pro** ■ Define your own customized mathematical notation
- Pro** ■ Extend functionality with discipline- and industry-specific add-on Libraries and Extension Packs

MathConnex visual programming environment

- Pro** ■ Obtain a high-level view of your project using the systems and data flow approach
- Pro** ■ Visually integrate and link applications and data sources to create heterogeneous computational systems
- Pro** ■ Assemble large projects visually by "wiring" together their subsystems
- Pro** ■ Access 19 visual drag-and-drop components to set up your systems, including Mathcad, Axum, S-PLUS, Excel, and MATLAB.

- Pro* ■ Use additional tools to activate, analyze, and debug your calculations.

Rich document preparation capabilities

- Create effective documents using flexible headers and footers
- Improve document layout with a variety of bulleted and numbered list styles
- Easily format paragraphs with advanced formatting options
- Produce consistent documents with templates and style sheets

- Pro* ■ Hide complex equations with collapsible areas

- Pro* ■ Guarantee document security with lock, unlock, and timestamp
- Develop groups of linked documents with easy hyperlinking
 - Speed through editorial changes with advanced Find and Replace
 - Simplify your writing tasks with convenient editing menus and shortcuts
 - Customize your toolbars to meet your needs
 - Ensure accuracy with technical spell checker

Effortless graphing and visualization

- Create instant bar plots, line graphs, polar plots, vector field plots, contour plots, scatter plots, and surface plots
- Use new annotation capabilities for plots
- Enhance your visualization capabilities with Trace and Zoom, animations, and image viewing
- Change parameters and watch your plots update automatically
- Visualize your functions easily using 2D QuickPlot
- Simplify plotting and select the best plot using the new 3D Plot Wizard
- Create multiple 3D plots on one graph
- Use the extensive 3D formatting options, including lighting, color, fog, surface properties, annotations, and axes, all rendered with state-of-the-art OpenGL graphics engine

Easy-to-use guidance tools

- Search the Resource Center for discipline-specific examples
- Reference hundreds of standard formulas and constants
- Select from over 300 QuickSheets covering standard analyses and tasks
- Rely on practical guides to statistics and problem solving
- Access regularly updated content through Mathcad's Web Library

- Consult the easy-to-use HTML Help system
- Get free individual Technical Support
- Quickly become productive using on-line tutorials

Web integration

- Save Mathcad worksheets as HTML format for Web publishing
- Browse “live” math and HTML documents
- Define hyperlinks locally or to the Web
- Join the Collaboratory, a free Mathcad Internet forum

The latest Microsoft standards

- New Microsoft Office 97–style user interface
- Customizable toolbars
- MAPI-based electronic mail support
- Complete OLE 2 and ActiveX support
- Windows NT, 95, and 98 compatible

New in Mathcad 8

Improved calculating power

- Mathcad boasts an all-new numerics engine and an updated symbolics engine designed for improved performance, consistency, and reliability.
- The built-in function set has been expanded in the areas of solving/optimization (see below), Bessel functions, number theory/combinatorics, probability, statistics, and data analysis. An improved Insert Function dialog box guides you in selecting and using built-in functions (Chapter 10).

New solver/optimizer

Mathcad’s solve block feature has been completely updated to be a general linear/nonlinear system solver and optimizer (see page 189):

- New *Maximize* and *Minimize* functions
- New linear programming support
- Support for much larger number of variables and unknowns
- Easier solve block definition (array notation, fewer required constraints)

- Unconstrained optimization
 - New constraint tolerance (CTOL) and advanced solving options
 - AutoSelect of appropriate solving algorithm
- Pro*
- Upgradability to the Expert Solver, which supports quadratic programming and has capacity to solve problems with even larger numbers of variables and unknowns

IntelliMath

- New algorithms for integration have been added, along with AutoSelect of the appropriate algorithm (page 164).

Pro

- AutoSelect of solving or integration routines can be manually overridden.
- Result formatting options now include binary radix support, control over the appearance of array results, and improved display of units in results (page 134).
- Many built-in functions that previously could not be applied to vectors without the explicit use of the vectorize operator can now process a vector directly, including trigonometric, logarithmic, Bessel, and probability distribution functions.

3D graphics

3D graphics, completely updated in Mathcad 8 based on the OpenGL graphics engine (Chapter 13), now feature:

- Improved display on screen and when printed
- A 3D Plot Wizard to simplify creation of different 3D plot types
- Direct mouse manipulation for rotating, zooming, and spinning
- Support for multiple surfaces
- Sophisticated formatting options (lighting models, color maps, fog, surface properties, contour lines, axes and labels, etc.) and high quality annotations

Text and document features

- Headers and footers support bitmaps, flexible text formatting, and flexible page numbering (page 108).

Pro

- Lockable regions in earlier versions have been replaced by areas, which can be collapsed, expanded, locked, and password protected (page 109).
- Text now supports bulleted and numbered lists, individual styles for each paragraph, full page width option, and easier selection (Chapter 5).
- Find and Replace have been improved to operate on phrases and punctuation marks (page 82).

Other improvements

- Updated on-line Help, Resource Center, and Collaboratory (Chapter 3)
- Customizable toolbars (page 16)
- Save Mathcad worksheets in Mathcad 7 or 6 format or as HTML or RTF (page 101)
- Improved formatting of array results (page 226)
- IntelliMouse support and Windows or Mathcad standard keystrokes (page 18)

Technical support

MathSoft provides free technical support for individual users of Mathcad. In the U.S. and Canada, contact MathSoft Technical Support:

- Email: *support@mathsoft.com*
- Fax: (617) 577-8829
- Automated support and fax-back system: (617) 577-1778
- Web: <http://www.mathsoft.com/support/support.html>
- Phone: (617) 577-1778

If you reside outside the U.S. and Canada, please refer to the technical support card to find details for your local support center. You may also contact:

- Automated solution center and fax-back system: +44 1276 475350
- Fax: +44 1276 451224
- Email: *help@mathsoft.co.uk*

Contact MathSoft or your local distributor for information about technical support plans for site licenses.

