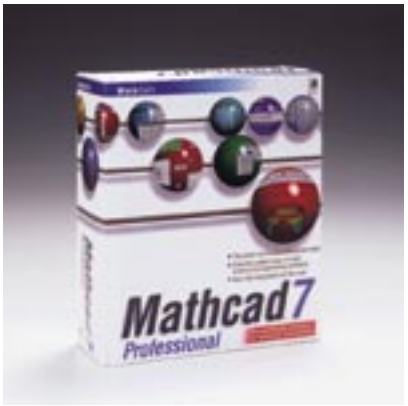
Mathcad ® 7 Professional



Platform: Windows 95/NT 3.51 or higher
Available for ground shipment

Mathcad 7 Professional is the industry's most complete numeric and symbolic calculation and visualization tool. Its unique worksheet interface lets you enter equations - in real math notation - and build graphs wherever you want. And because it's live, you get instant feedback as you try different approaches. The new Windows 95/NT interface offers OLE 2 client and server support, drag and drop capabilities including in-place activation, insert object and data input and output filters to popular spreadsheets, databases and more. Annotate with text. Work with content from other sources utilizing the new MathConnex™ feature which lets you visually integrate and manage data and computations between different applications. Browse live math and HTML from within Mathcad seamlessly using Microsoft® Internet Explorer (included FREE inside Mathcad 7) and collaborate with others on the Web or your LAN. Mathcad 7 Professional makes exploring and solving complex problems - as well as documenting and communicating their solutions - easier than ever before.

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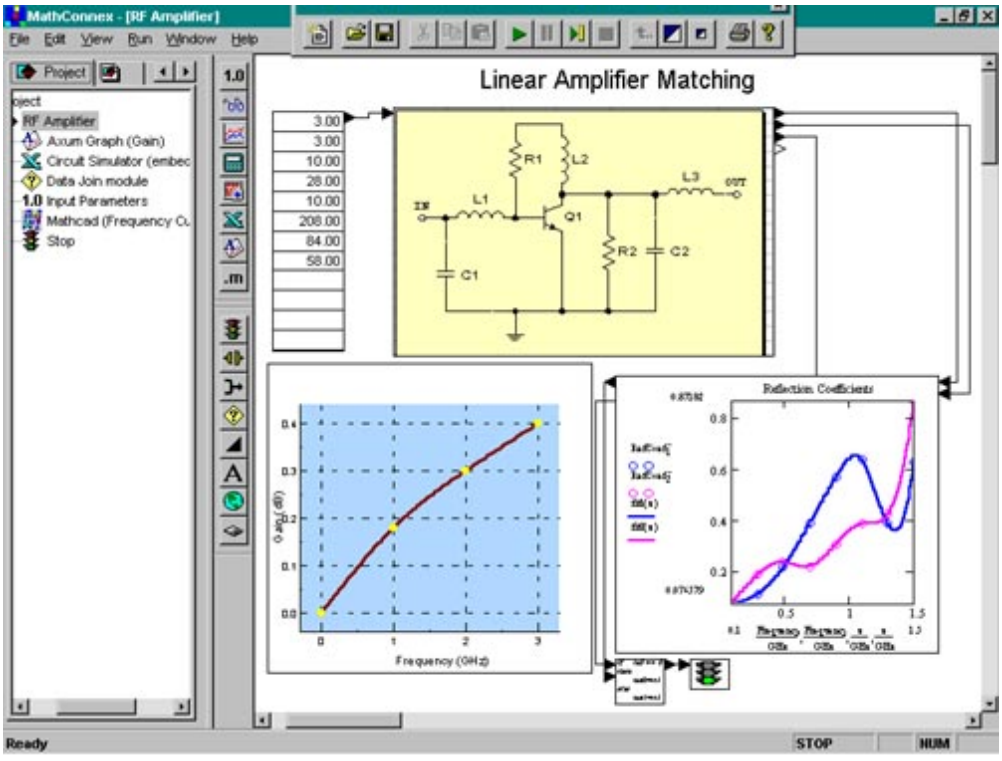
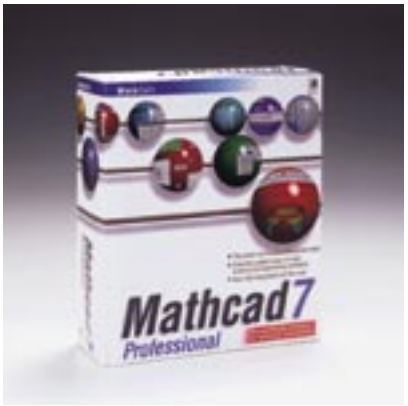


Combine a circuit diagram from Visio® with data from Excel. Send the gain frequency and other data to Mathcad and perform regressions and analyses. Plot the reflection and coefficients. Wire it all together and choose RUN. You've got your entire system. We call it MathConnex™.

Mathcad 7 Professional includes advanced math functionality, improved usability, smart automatic unit conversion, powerful functional programming and new electronic content and guidance features which make it the clear choice as the technical professional's choice.

Mathcad® 7 Professional



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Mathcad 7 Professional Full Feature Listing

Mathcad Professional provides hundreds of operators and built-in functions for solving technical problems from the simple to the very complex. Mathcad can be used to perform numeric calculations or to find more general and precise symbolic solutions.

ADVANCED Math Functionality

- Handle real, imaginary and complex numbers, and dimensional values
- Operators and built-in functions for manipulating numbers, vectors and matrices
- Numeric systems solving & minimization
- Derivatives, integrals, summations and products
- Trigonometric, hyperbolic, exponential and Bessel functions
- Fast Fourier and wavelet transforms
- Symbolic calculations are live. Make a change, and Mathcad updates the symbolic result
- Symbolic solutions to individual equations or systems of equations
- Symbolic integration and differentiation, limits and series
- Expand, simplify and factor expressions
- Laplace, z, Fourier integral transforms and their inverses
- Inverse, transpose and determinant of a matrix, and eigenvalues and eigenvectors
- 20 operators to manipulate arrays, nested arrays and matrices
- Advanced linear algebra functions, including Cholesky, QR, LU and SV decomposition
- 13 ordinary and partial differential equation solvers to solve ordinary differential equations, systems of differential equations and boundary value problems
- 64 statistical functions support standard and advanced methods of analysis, including parametric and non-parametric hypothesis testing, analysis of variance, and Monte Carlo techniques
- Compute the frequency distribution for histograms
- Curve fitting and surface interpolation
- Data smoothing functions are provided for smoothing time series with either a running median, a Gaussian kernel, or an adaptive linear least squares method

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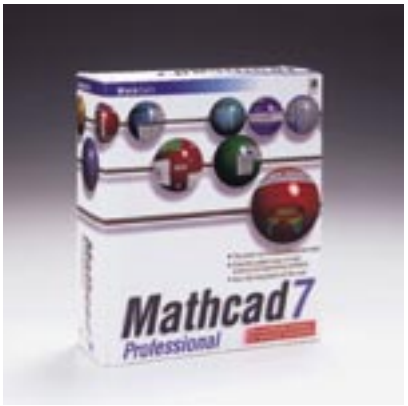

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NEW MathConnex™
- Define & link drag-and-drop MathConnex components, including data input and output tables, Excel, MATLAB™ and conditionals
- Integrate & manage data and computations between different applications
- Analyze and debug calculations
- Automate embedded components using VBScript or JScript™

POWERFUL Functional Programming
- Procedural operators for building functional programs
- Define local variables, strong variables, complex data structures and nested arrays
- Looping, recursion, conditional branching, with Return and Continue statements
- Run-time error-handling with On Error statement
- Program with live symbolic expressions

COMPLETE Extensibility
- Set up your own function libraries
- User defined notation
- Create your own functions using C or C++ programming language
- Extend functionality with discipline-specific add-on packs
- Access more 2D and 3D graph and plot types by working with Axum®

SMART Automatic Unit Conversion
- Automatically tracks & converts your units
- Complete SI unit system
- MKS, CGS, and U.S. customary units

NEW Data Input/Output
- Move data in and out of Mathcad quickly
- Data filters for Excel files, MATLAB .mat files, ASCII and more

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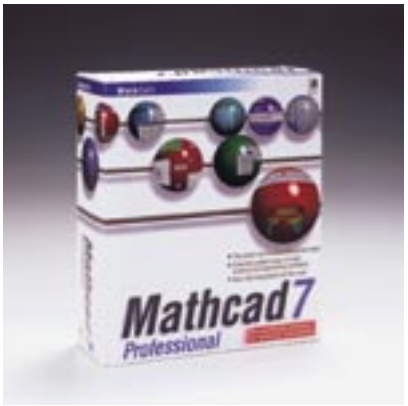

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And Mathcad Professional is completely wired for today's technical desktop, integrating presentation and collaboration tools and the resources of the Internet into one dynamic workspace.

IMPROVED Usability

- New Windows NT & 95 user interface and conventions, including context menus
- Create libraries of frequently used functions
- Easier equation entry and editing
- OLE 2 client and server support, providing in-place activation and inter-application drag-and-drop
- OLE 2 automation support using VBScript and JScript™

EXTENSIVE Formatting & Document Preparation Capabilities

- Technical spell checker
- Document templates, style sheets, and region formatting
- Lock regions, hide & unhide
- Include equations in text and highlight equations
- Page setup control and print preview

INNOVATIVE Web Integration

- Browse "live" math and HTML from within Mathcad, using Microsoft® Internet Explorer (included for FREE inside)
- Define hyperlinks locally or to the Web
- MAPI-based E-mail support
- Join the Collaboratory™, a free Internet forum serving the worldwide Mathcad community

NEW Electronic Content & Guidance

- 300 QuickSheets™ covering standard analyses and tasks
- Technical Reference Tables
- Guides to Practical Statistics, Problem Solving and Programming in Mathcad
- Regularly-updated content through Mathcad's Web Link
- On-line help, tutorial, search-by-subject index, context-sensitive help, user's guide, and free individual technical support

INTELLIGENT Visualization Tools

- Use QuickPlot™ to instantly graph an expression
- Interactive 2D and 3D graphs, including X-Y, scatter, bar, polar, vector, contour, and parametric surface
- Trace & Zoom, animation, image viewing

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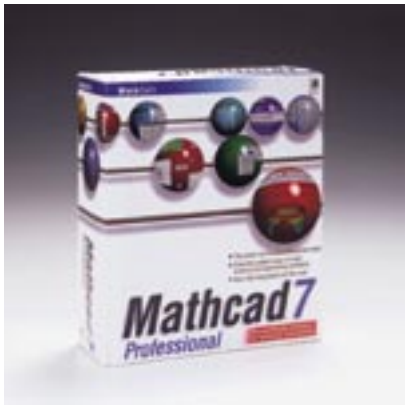

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Complex Solutions to Ordinary Differential Equations

The numerical differential equation solvers in **Mathcad PLUS 6.0** produce real numbers representing the values of real-valued functions which are solutions to ODEs. In some cases you may seek complex-valued solutions when the independent variable is real.

Consider the ODE

$$\frac{d}{dt}Z(t) - t \cdot Z(t) = \sin(Z(t)) \qquad Z(0) = -2 + i$$

where **t** is a real variable but we seek values for a complex-valued function **Z(t)**.

We can convert this into a system of equations in the real and imaginary parts of **Z(t)**.

Substitute $Z(t) = X(t) + i \cdot Y(t)$

where **X(t)** and **Y(t)** are real functions of **t**:

$$\frac{d}{dt}(X(t) + i \cdot Y(t)) - t \cdot (X(t) + i \cdot Y(t)) = \sin(X(t) + i \cdot Y(t))$$

If we expand both sides of this expression

$$\frac{d}{dt}(X(t) + i \cdot Y(t)) - t \cdot (X(t) + i \cdot Y(t))$$

expands to

$$\frac{d}{dt}X(t) + i \cdot \frac{d}{dt}Y(t) - t \cdot X(t) - i \cdot t \cdot Y(t)$$

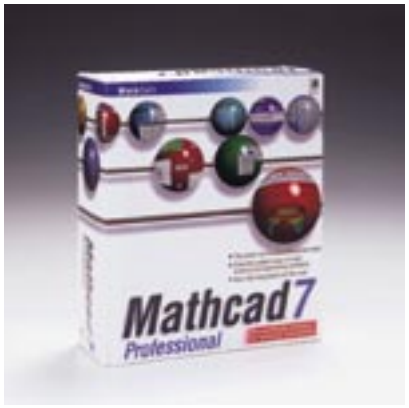
expands to

$$\sin(X(t)) \cdot \cosh(Y(t)) + i \cdot \cos(X(t)) \cdot \sinh(Y(t))$$

and compare the real and imaginary parts, we get:

$$\frac{d}{dt}X(t) - t \cdot X(t) = \sin(X(t)) \cdot \cosh(Y(t))$$ real parts

$$\frac{d}{dt}Y(t) - t \cdot Y(t) = \cos(X(t)) \cdot \sinh(Y(t))$$ imaginary parts



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This is a system in the real-valued functions **X(t)** and **Y(t)**. The initial condition

$$Z(0) := -2 + i$$

yields

$$X(0) := -2 \qquad Y(0) := 1$$

We may now solve this system in the usual manner using one of our built-in numerical DE solving functions. Define

$$IC := \begin{pmatrix} -2 \\ 1 \end{pmatrix} \qquad t0 := 0$$

$$t1 := 5 \qquad N := 500$$

$$D(t, Z) := \begin{pmatrix} \sin(Z_0) \cdot \cosh(Z_1) + t \cdot Z_0 \\ \cos(Z_0) \cdot \sinh(Z_1) + t \cdot Z_1 \end{pmatrix}$$

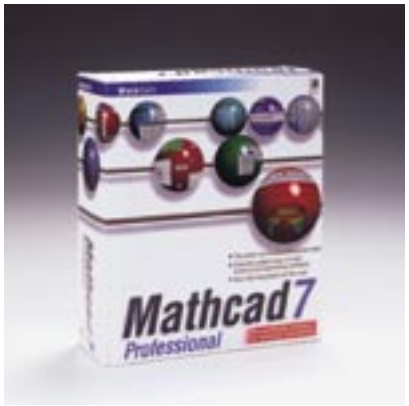
and solve using the adaptive Runge-Kutta routine **Rkadapt**:

$$C := \text{Rkadapt}(IC, t0, t1, N, D)$$

The columns of **C** now contain values for t along with **X(t)** and **Y(t)**, which determine the values of **Z**.

Define

$$t := C^{\langle 0 \rangle} \qquad Z := C^{\langle 1 \rangle} + i \cdot C^{\langle 2 \rangle} \qquad i := 0 .. N$$



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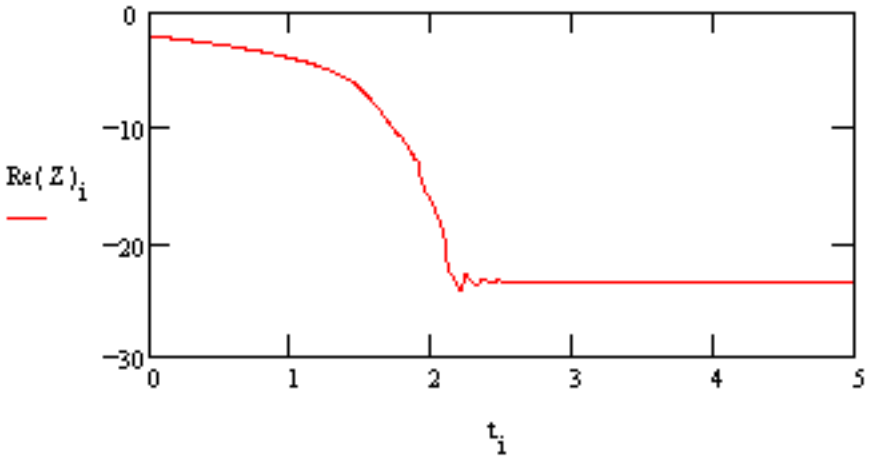
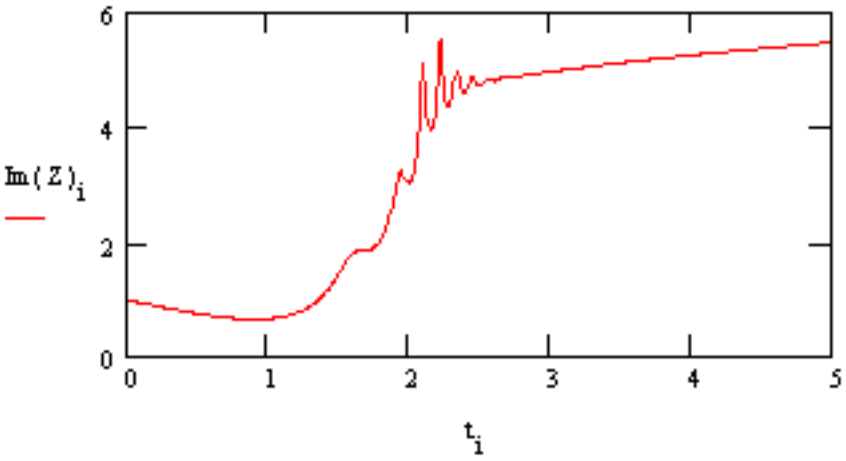
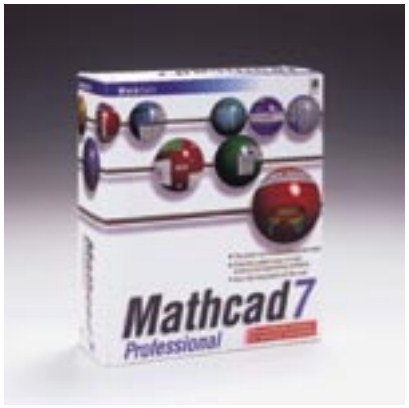
and we can view the real part over time,



and the imaginary part:





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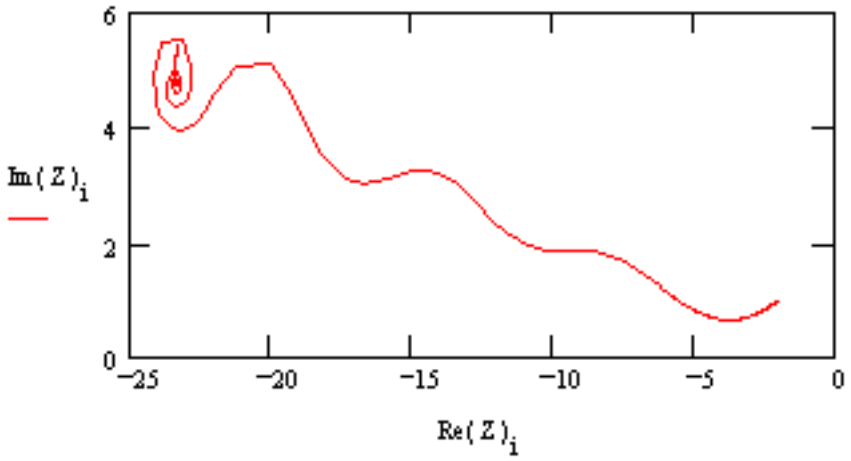
We can also look at the curve traced in the complex plane as **t** varies:



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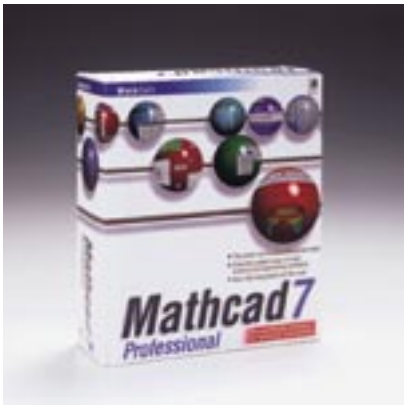

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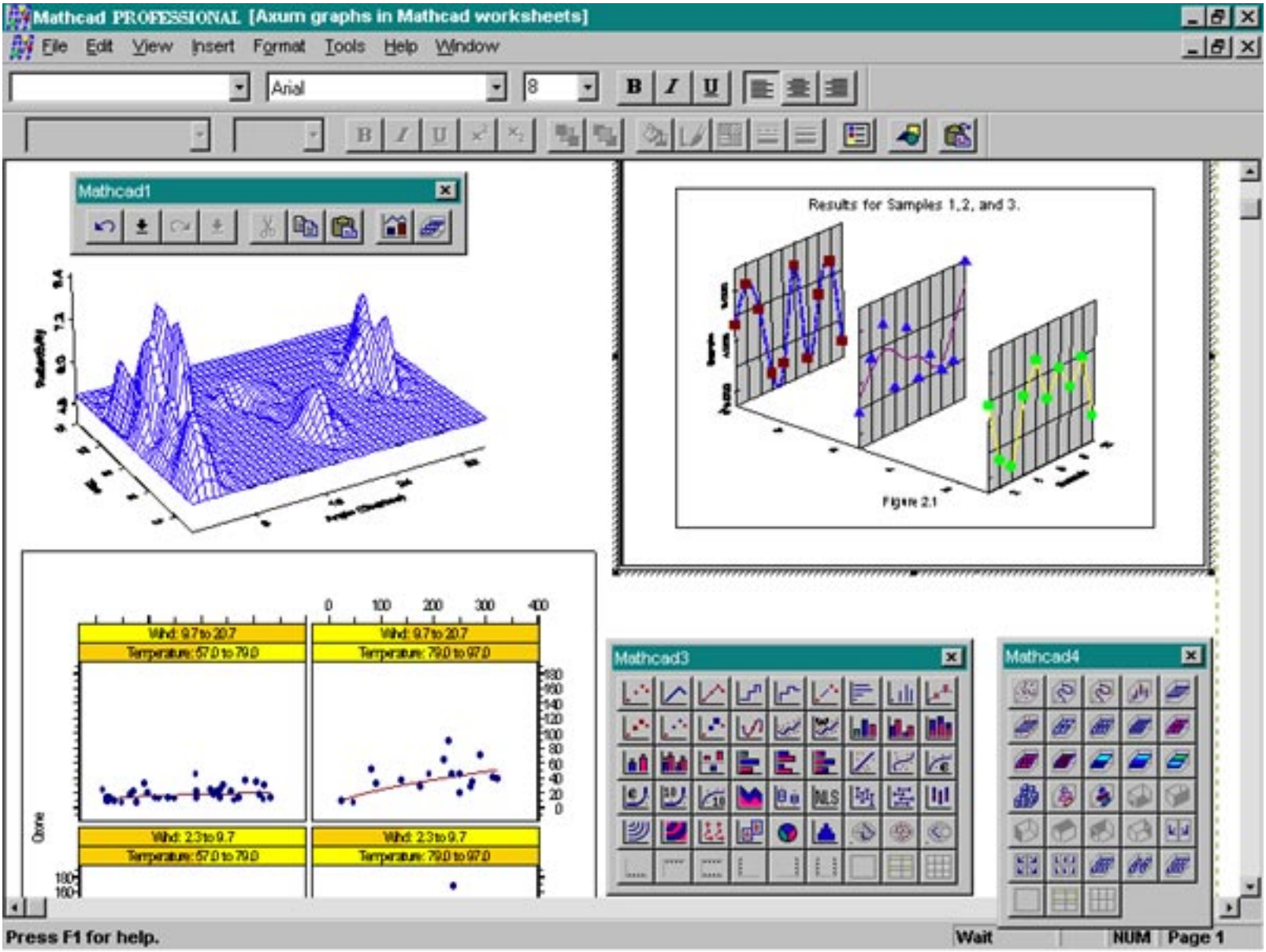

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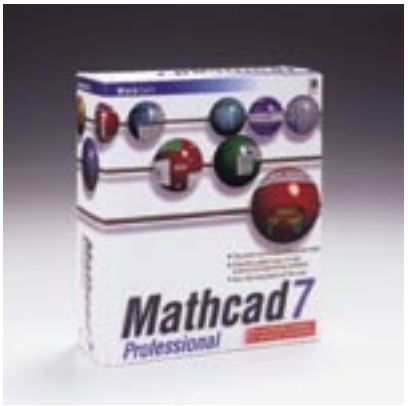

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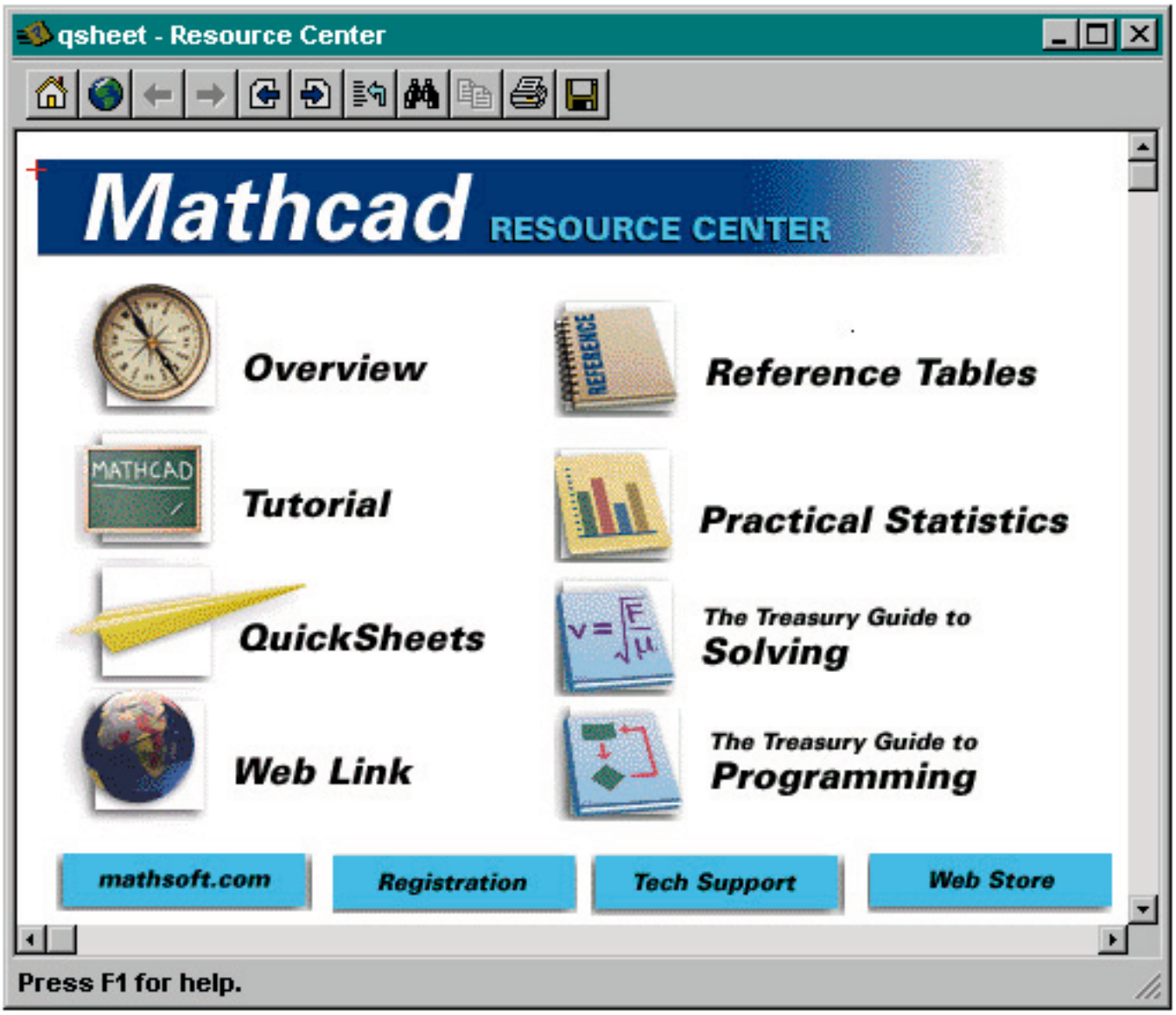

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