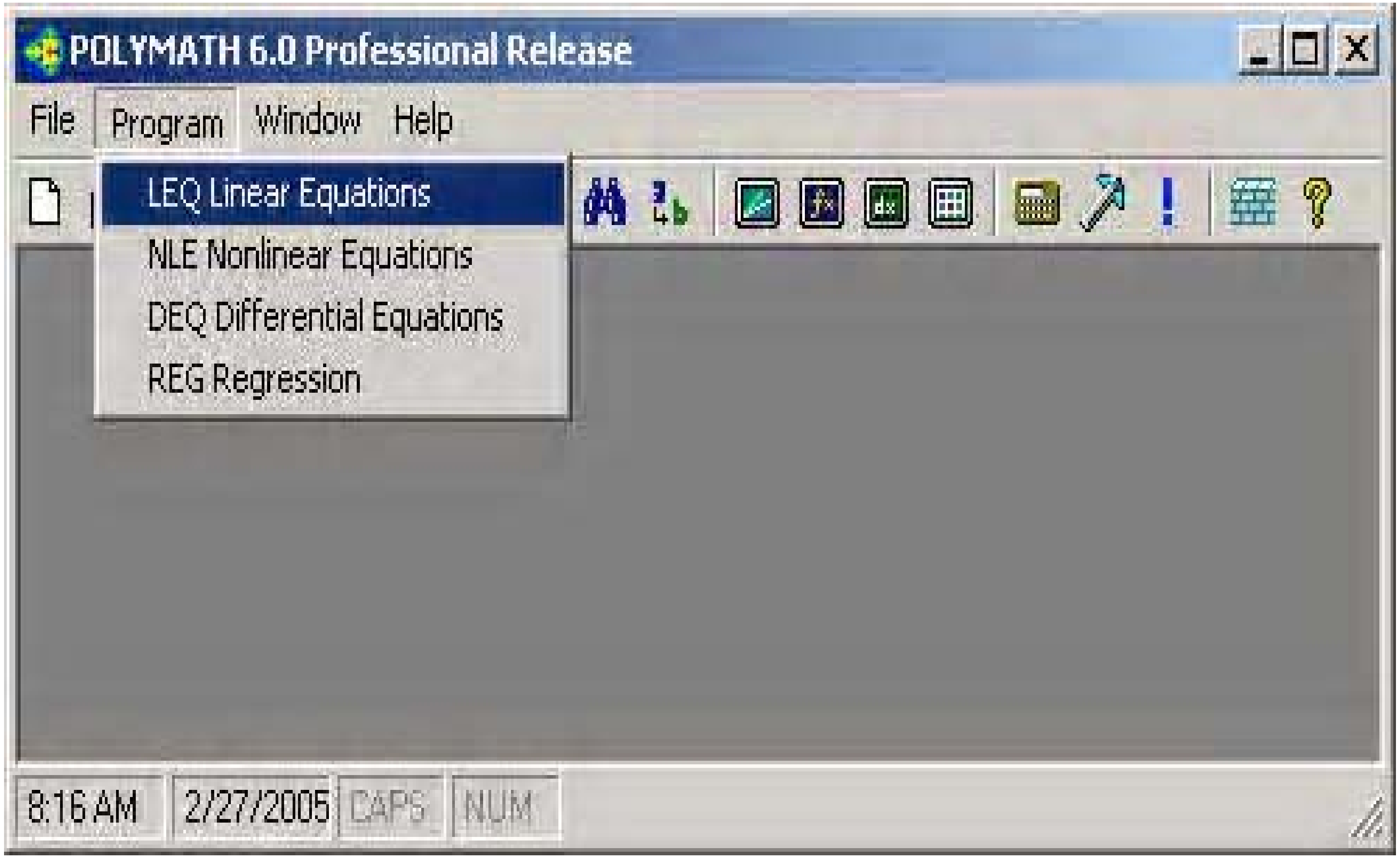
Polymath 6

Overview

Main Polymath Menu



LEQ: Linear Equations Solver. Enter (in matrix form) and solve a new system of simultaneous linear equations.

NLE: Nonlinear Equations Solver. Enter and solve a new system of nonlinear algebraic equations.

DEQ: Differential Equations Solver. Enter and solve a new system of ordinary differential equations.

REG: Data Table with Analysis and Regression. Enter, analyze, regress, and plot set of data points.

calc: Calculator. Enter and evaluate explicit expressions with a variety of intrinsic functions.

units: Unit Converter. Convert selected units into desired units.

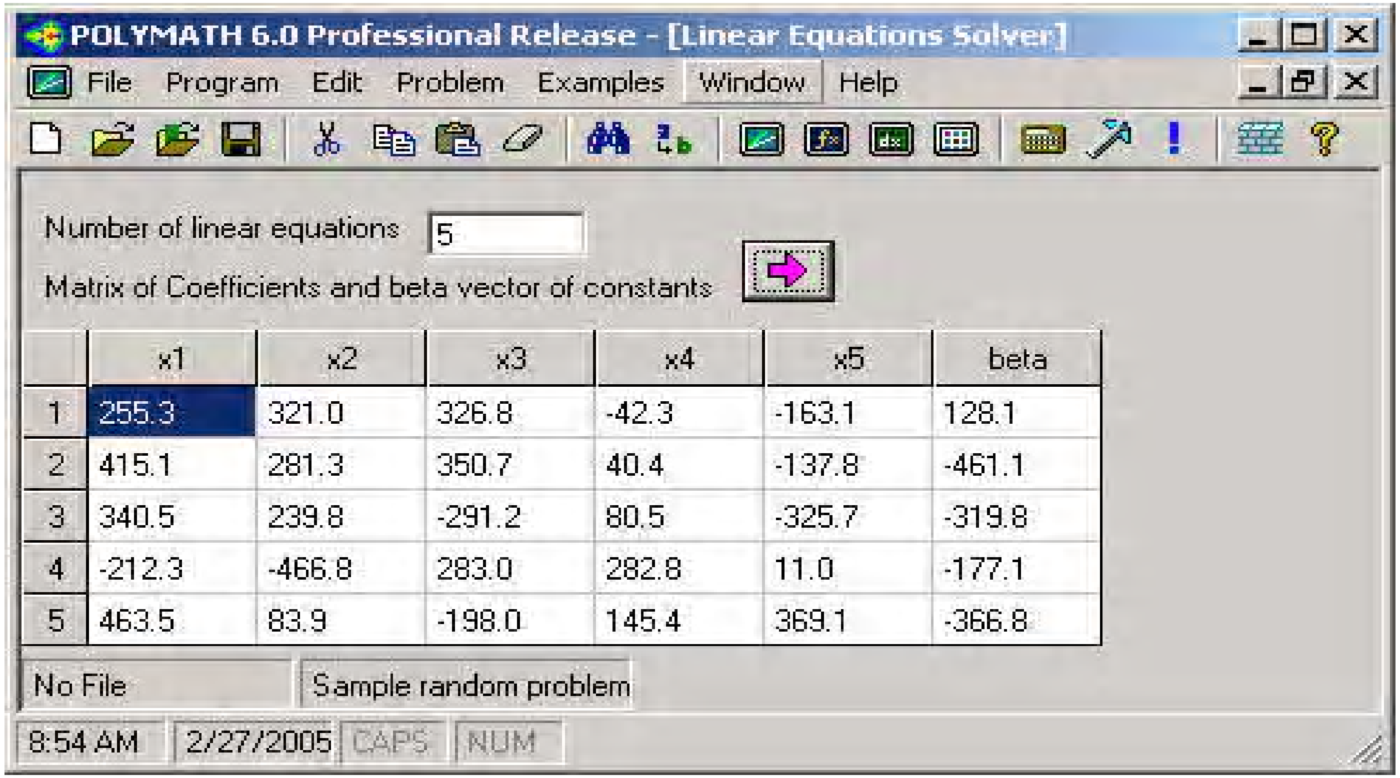
const: Scientific Constants. Find selected scientific and engineering constants.

setup: Parameter Settings. Modify setup and parameters of numerical solution algorithms.

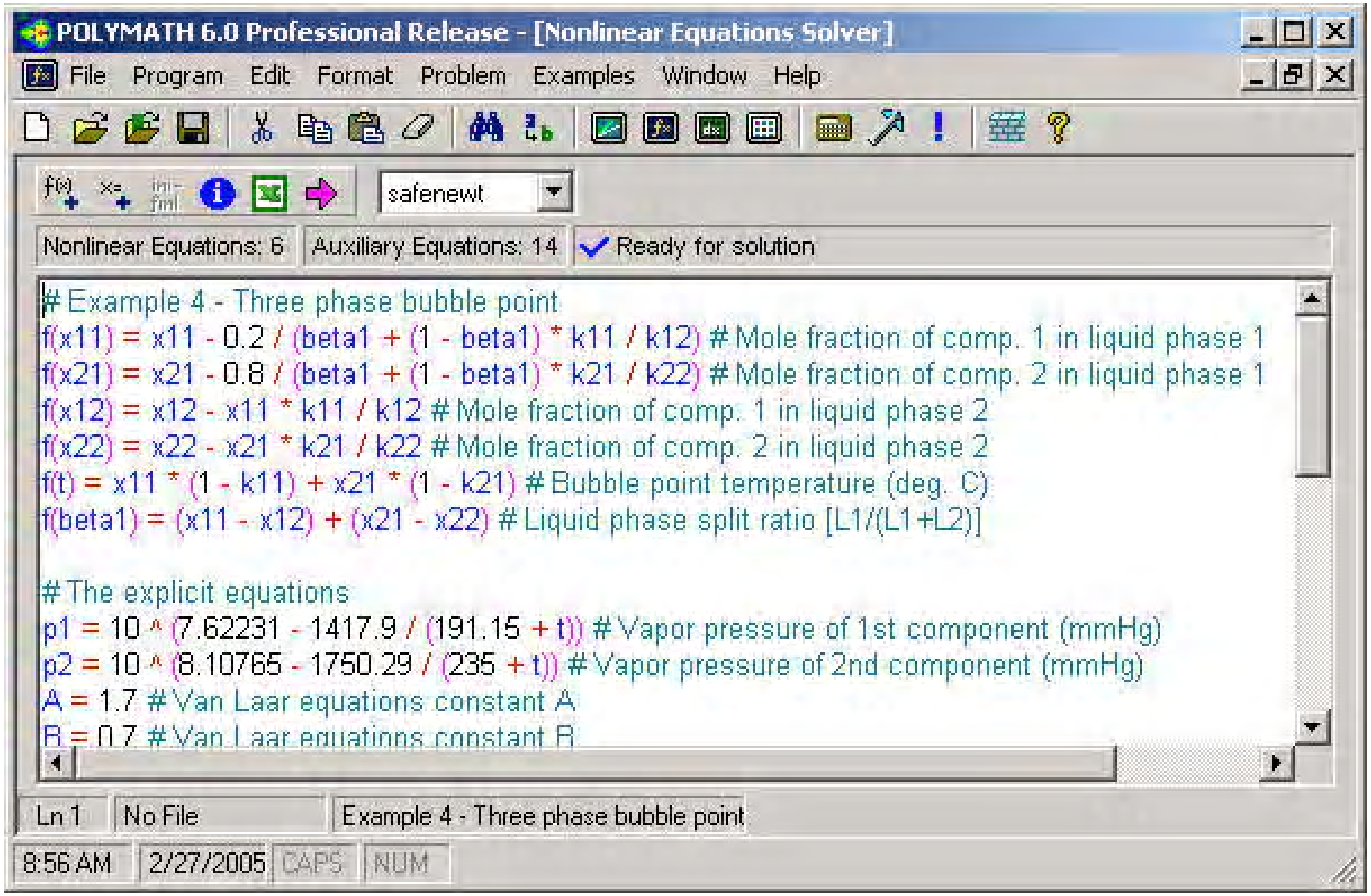
HELP: Extensive HELP is always available. Also F1 always given

Linear Equations Solver

- The purpose of this program is to allow you to solve systems of linear algebraic equations where the set of linear equations is inputted in a matrix-vector form.



Nonlinear Equations Solver



The options and information available on this screen are the following:

Input a new nonlinear (implicit) algebraic equation.

Input a new explicit algebraic equation.

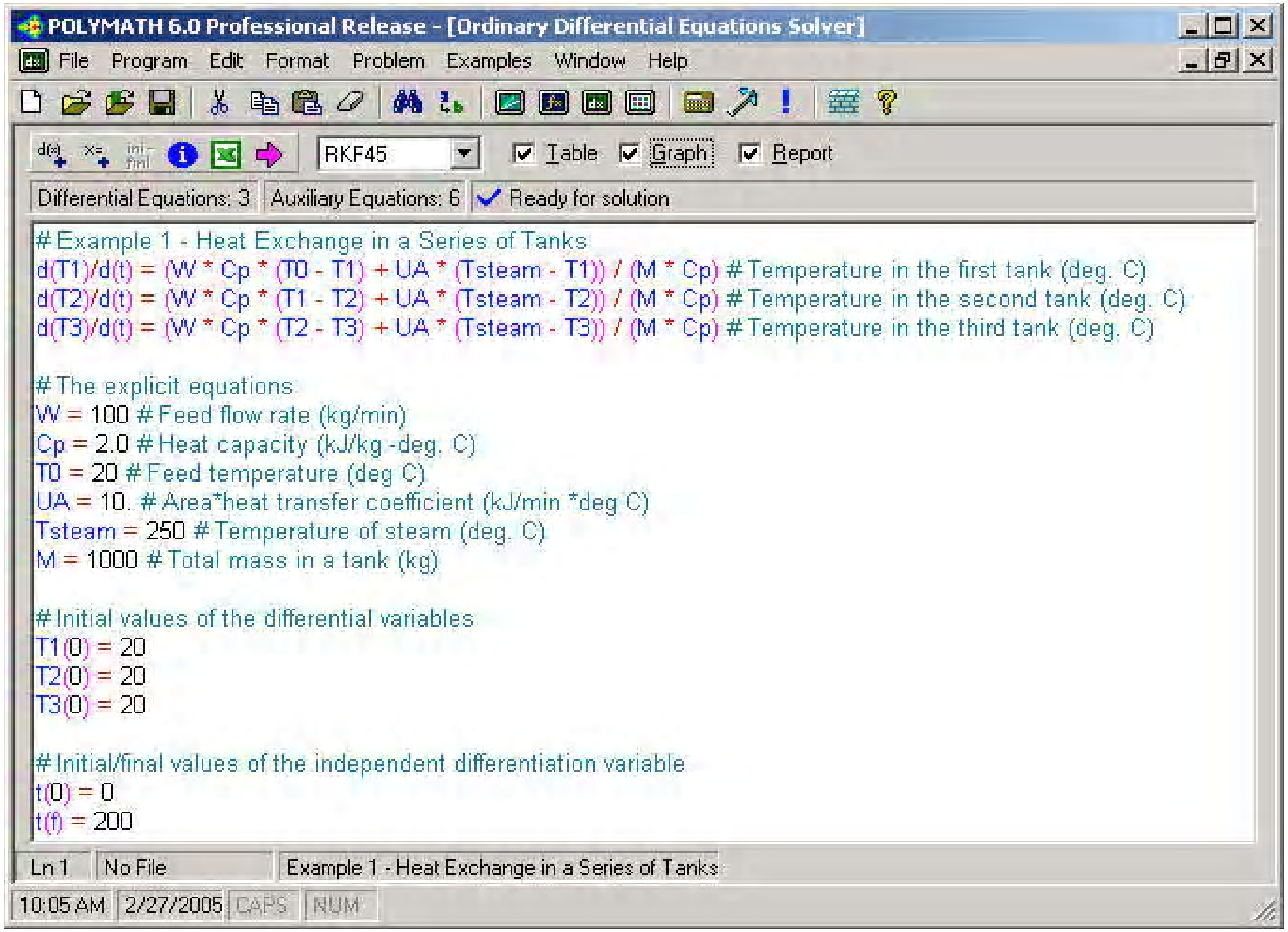
Input minimum and maximum values for single nonlinear equation.

View the currently defined problem variables.

Export current problem to Excel.

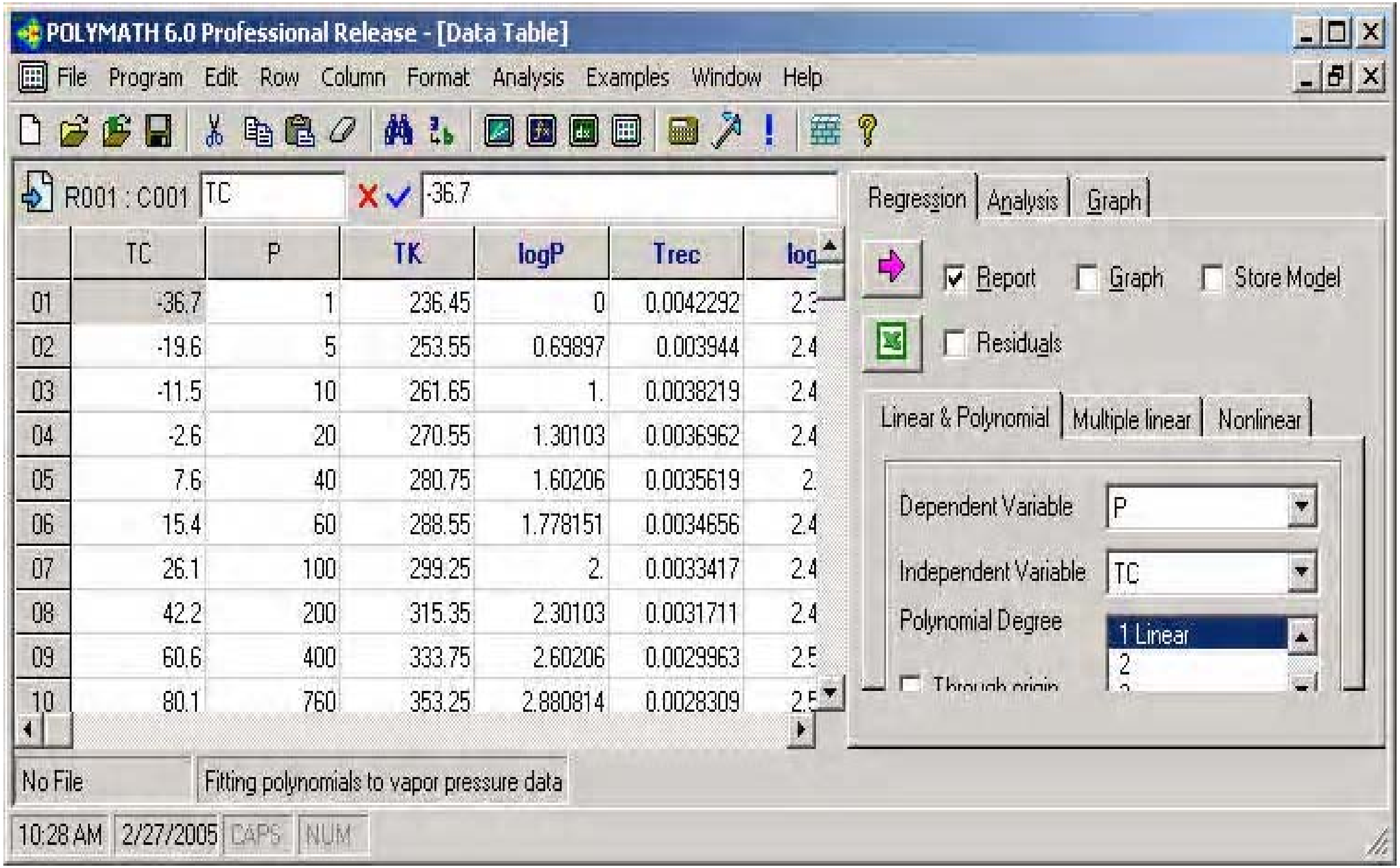
Solve current problem (pink color when problem correctly entered).

Differential Equations Solver

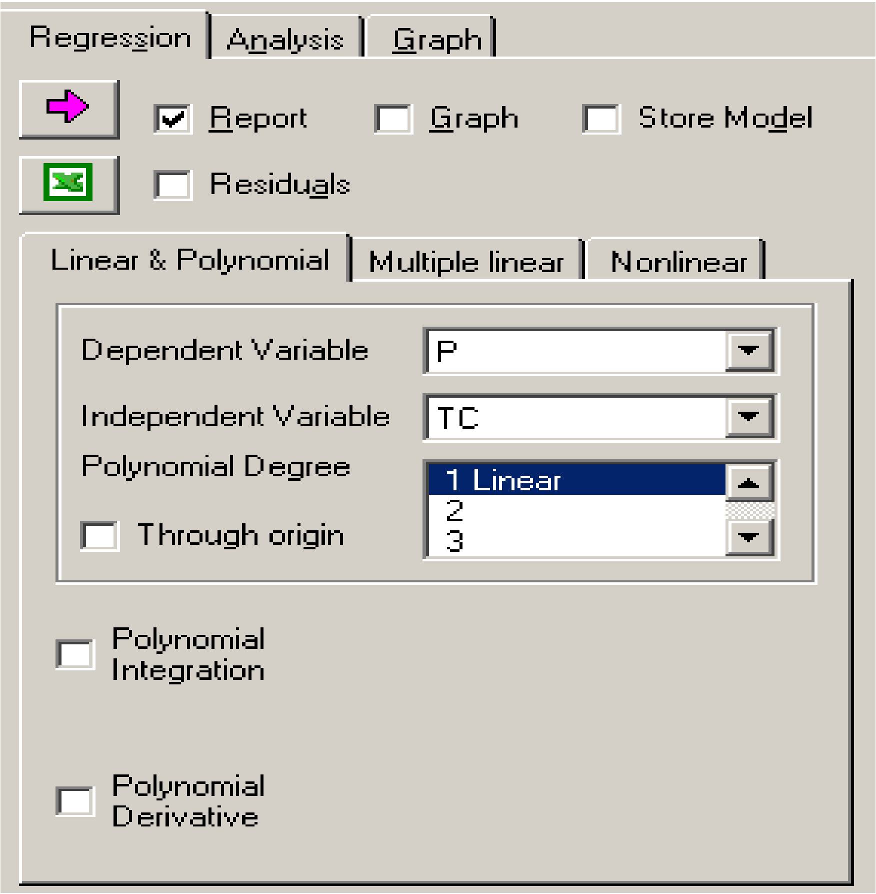


Data Table for Regressions, Curve Fitting, and General Plotting

The data table is used for input, manipulation and storage of numerical data. The data is stored in a column-wise fashion where every column is associated with a name (variable) and can be addressed separately. The stored data can be regressed (link to Regression), analyzed (link to data analysis) and plotted.


POLYMATH 6.0 Professional Release - [Data Table]
File Program Edit Row Column Format Analysis Examples Window Help
R001 : C001
TC
-36.7
TC P TK logP Trec log
01 -36.7 1 236.45 0 0.0042292 2.3
02 -19.6 5 253.55 0.69897 0.003944 2.4
03 -11.5 10 261.65 1. 0.0038219 2.4
04 -2.6 20 270.55 1.30103 0.0036962 2.4
05 7.6 40 280.75 1.60206 0.0035619 2.
06 15.4 60 288.55 1.778151 0.0034656 2.4
07 26.1 100 299.25 2. 0.0033417 2.4
08 42.2 200 315.35 2.30103 0.0031711 2.4
09 60.6 400 333.75 2.60206 0.0029963 2.5
10 80.1 760 353.25 2.880814 0.0028309 2.5
Regression Analysis Graph
Report Graph Store Model
Residuals
Linear & Polynomial Multiple linear Nonlinear
Dependent Variable P
Independent Variable TC
Polynomial Degree
1 Linear
2
No File
Fitting polynomials to vapor pressure data
10:28 AM 2/27/2005 CAPS NUM

The window for the Regression/Linear & Polynomial option is shown below.

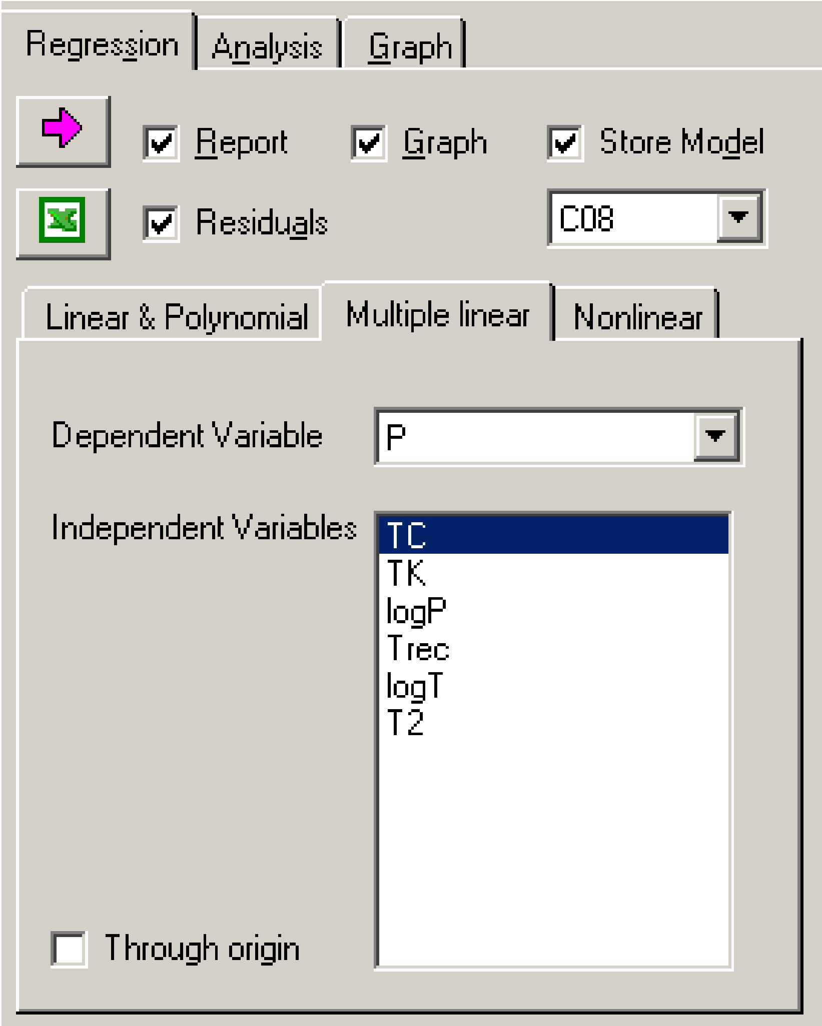


Multiple Linear Regression

- This part of the program will fit a linear function of the form:

  y(x1, x2, …, xn) = a0 + a1*x1 + a2*x2 + … + an*xn

  where a0, a1, …, an are regression parameters, to a set of N tabulated values of x1, x2, …, xn (independent variables) versus y (dependent variable). Note that the number of data points must be greater than n+1 (thus N >= n+1). The program calculates the coefficients a0, a1, …, an by minimizing the sum of squares of the deviations between the calculated and the data for y.



- Solve current problem (pink color when problem correctly entered).

- Show a report showing the regression model the numerical values and confidence intervals of the parameters and other statistical information.

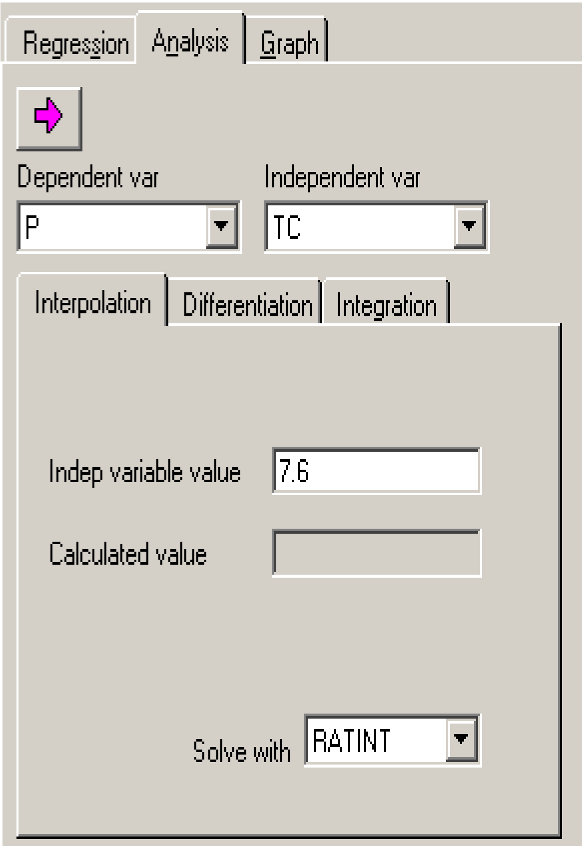
- Graph the calculated curve (or points) and the data points .

- Store Model - Places output model results within Daa Table.

- Export problem to Excel (highlighted when problem is correctly entered).

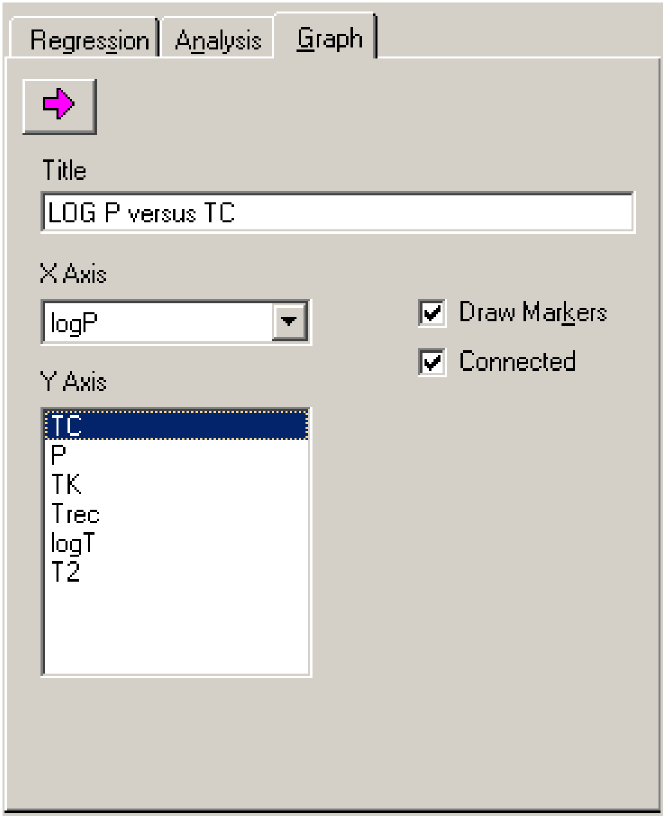
- A residual plot is displayed showing the deviation between the data and the calculated values of the dependent variable.

Data Analysis



Interpolation - Calculates the value of the dependent variable for a specified value of the independent variable .
Differentiation - Calculates the derivative of the dependent variable for a specified value of the independent variable.
Integration - Calculates the integral of the dependent variable for a specified region of the independent variable.
Dependent variable - Select any column from the Data Table as the dependent variable.

Graph Preparation and Editing



The graph editing options can be reached using the icon buttons on the left of the window. Representative options are listed below.

Max Y-axis - Change the upper bound on the Y (vertical) axis.

Min Y-axis - Change the lower bound on the Y (vertical) axis.

Max X-axis - Change the upper bound on the X (horizontal) axis.

Min X-axis - Change the lower bound on the X (horizontal) axis.

Scatter Sonnected - Show the curve connecting the calculated and/or stored data points.

Draw points - Show the calculated and/or stored data points.

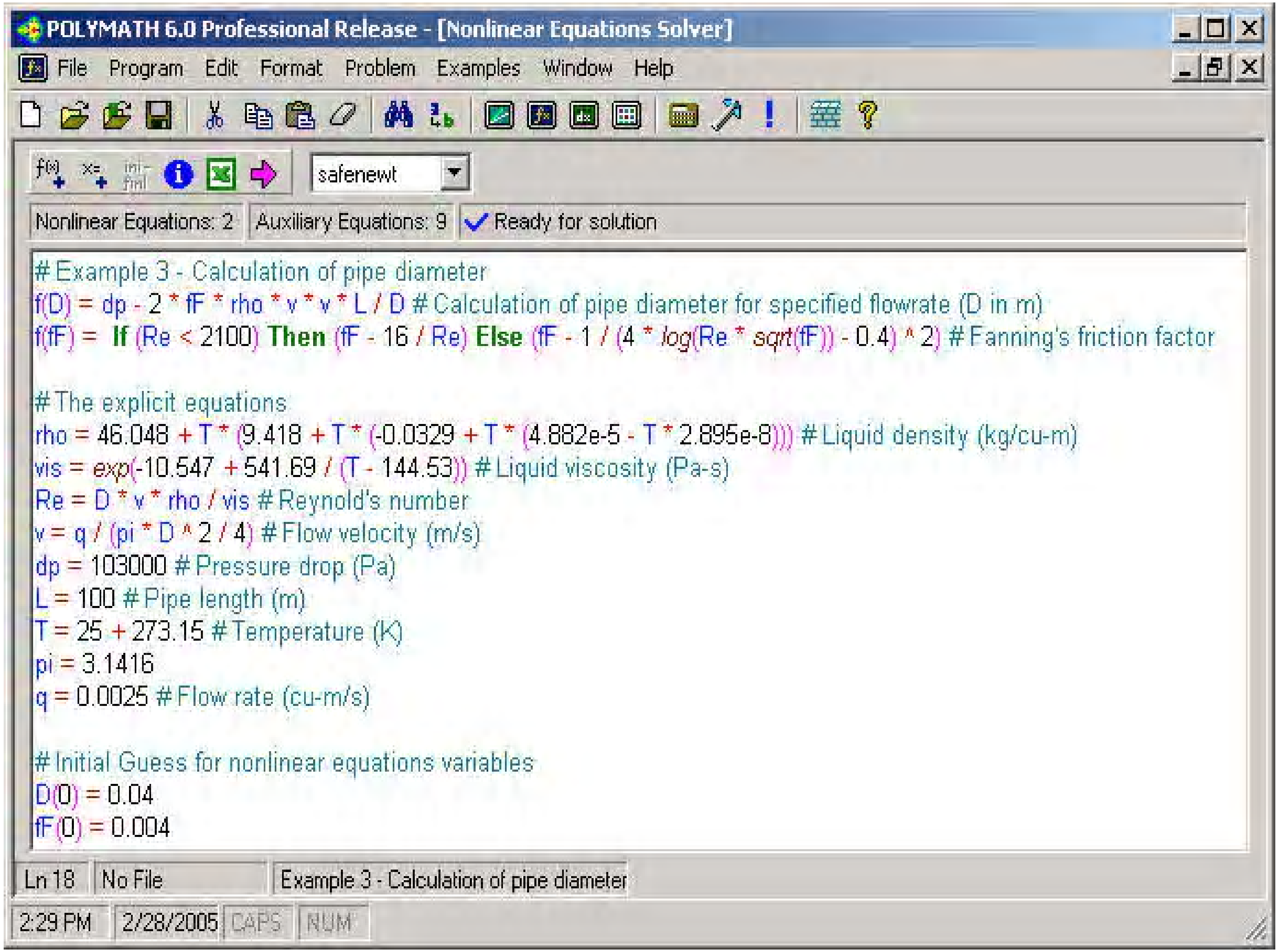
Auto scale - Determines whether the program automatically changes the scale as users remove/add function curves.

Curves and Functions - Option to remove variables and to add function plots to the graph.

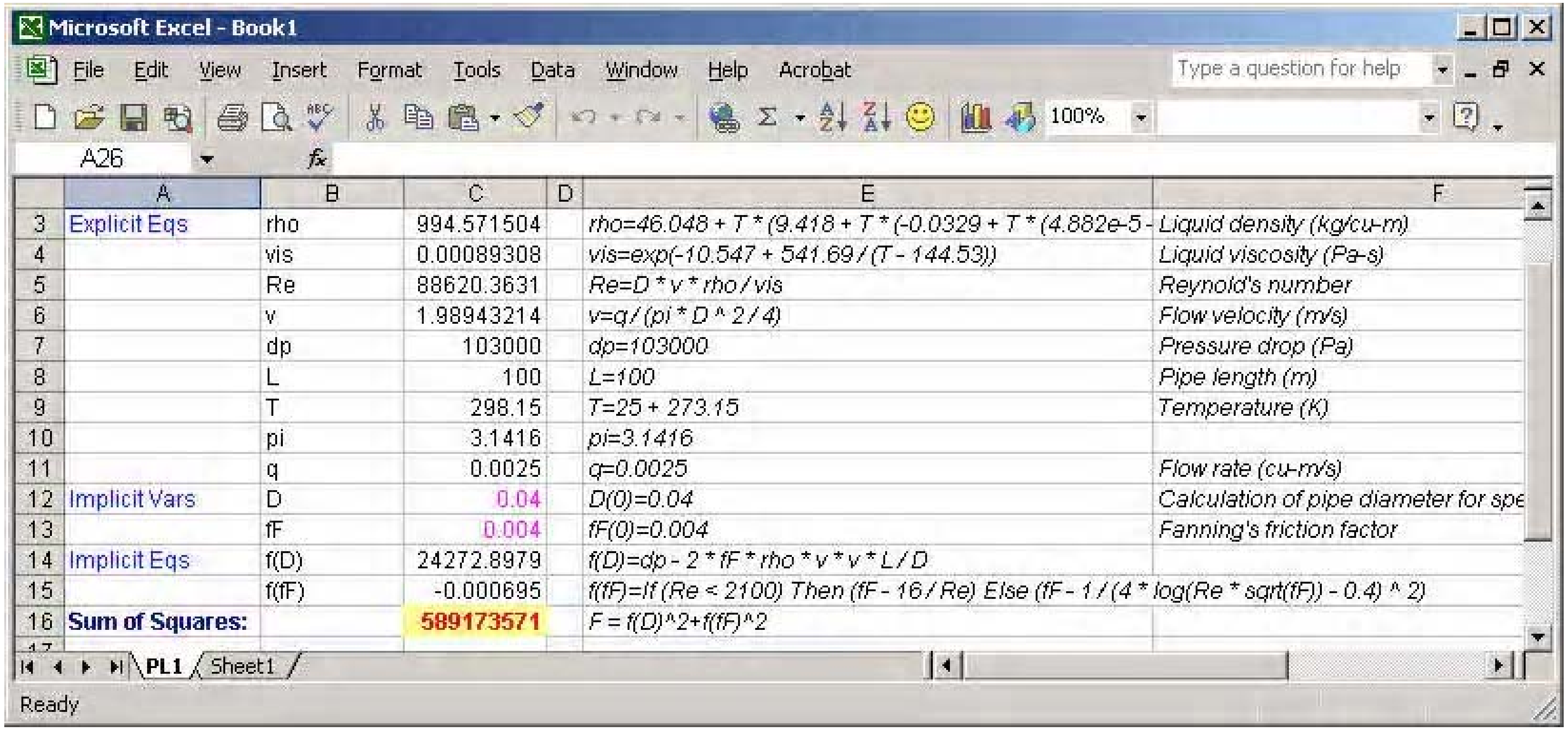
Exporting to Excel

- The "Export to Excel" function of Polymath is found in all program except the Linear Equation Solver. This option becomes available whenever the current problem in Polymath has been entered completely and the Excel icon is active. The desired Excel Workbook must be opened on the computer before the problem is exported to Excel.

A sample problem is ready for solution within Polymath and the Excel icon is colored green..



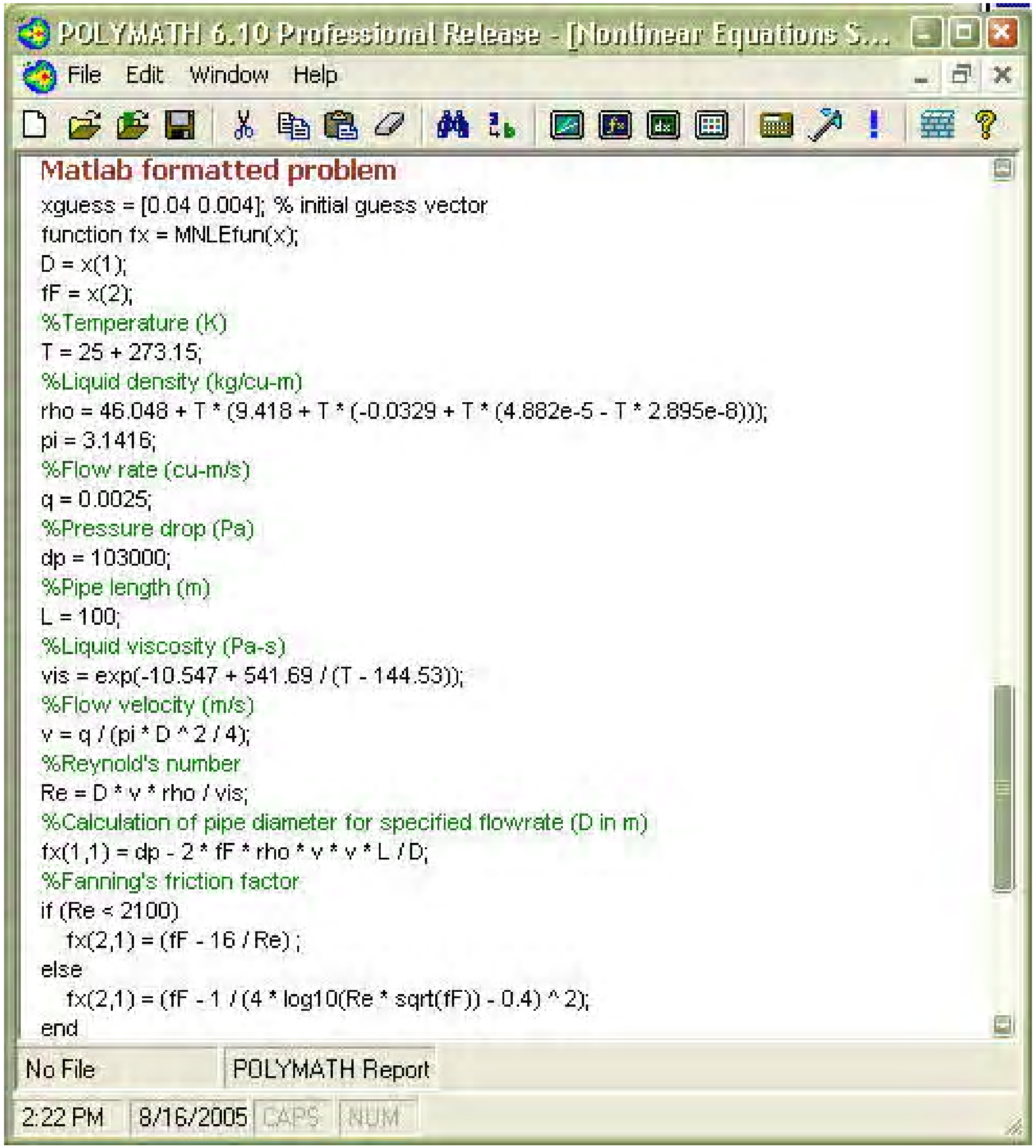
A single click on the Excel icon or selection from the Problem menu causes the problem to be automatically exported into Excel as shown below



	A	B	C	D	E	F
3	Explicit Eqs	rho	994.571504		rho=46.048 + T * (9.418 + T * (-0.0329 + T * (4.882e-5 -	Liquid density (kg/cu-m)
4		vis	0.00089308		vis=exp(-10.547 + 541.69 / (T - 144.53))	Liquid viscosity (Pa-s)
5		Re	88620.3631		Re=D * v * rho / vis	Reynold's number
6		v	1.98943214		v=q / (pi * D ^ 2 / 4)	Flow velocity (m/s)
7		dp	103000		dp=103000	Pressure drop (Pa)
8		L	100		L=100	Pipe length (m)
9		T	298.15		T=25 + 273.15	Temperature (K)
10		pi	3.1416		pi=3.1416	
11		q	0.0025		q=0.0025	Flow rate (cu-m/s)
12	Implicit Vars	D	0.04		D(0)=0.04	Calculation of pipe diameter for spe
13		fF	0.004		fF(0)=0.004	Fanning's friction factor
14	Implicit Eqs	f(D)	24272.8979		f(D)=dp - 2 * fF * rho * v * v * L / D	
15		f(fF)	-0.000695		f(fF)=If (Re < 2100) Then (fF - 16 / Re) Else (fF - 1 / (4 * log(Re * sqrt(fF)) - 0.4) ^ 2)	
16	Sum of Squares:		589173571		F = f(D)^2+f(fF)^2	

Creating MATLAB Files

- The equations and comments from the Nonlinear Equation Solver and the Differential Equations Solver can be automatically generated in complete MATLAB "M" file format.
- The MATLAB "M" file is placed in the Polymath Nonlinear Equations Report as shown, and this code can be copied directly into the MATLAB editor


POLYMATH 6.10 Professional Release - [Nonlinear Equations S...
File Edit Window Help
Matlab formatted problem
xguess = [0.04 0.004]; % initial guess vector
function fx = MNLEfun(x);
D = x(1);
fF = x(2);
%Temperature (K)
T = 25 + 273.15;
%Liquid density (kg/cu-m)
rho = 46.048 + T * (9.418 + T * (-0.0329 + T * (4.882e-5 - T * 2.895e-8)));
pi = 3.1416;
%Flow rate (cu-m/s)
q = 0.0025;
%Pressure drop (Pa)
dp = 103000;
%Pipe length (m)
L = 100;
%Liquid viscosity (Pa-s)
vis = exp(-10.547 + 541.69 / (T - 144.53));
%Flow velocity (m/s)
v = q / (pi * D ^ 2 / 4);
%Reynold's number
Re = D * v * rho / vis;
%Calculation of pipe diameter for specified flowrate (D in m)
fx(1,1) = dp - 2 * fF * rho * v * v * L / D;
%Fanning's friction factor
if (Re < 2100)
fx(2,1) = (fF - 16 / Re) ;
else
fx(2,1) = (fF - 1 / (4 * log10(Re * sqrt(fF)) - 0.4) ^ 2);
end
No File
POLYMATH Report
2:22 PM
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MATLAB Output from Differential Equations Solver