EGR 120
Introduction to Engineering
File: SOLVE.MCD

MathCad Example: Using SOLVE BLOCKS

A very powerful feature within MATHCAD is the SOLVE BLOCK. The SOLVE BLOCK allows you to analyze a wide variety of problems according to a set of constraints that you specify. Several examples are shown below.

Example 1: Solving Simultaneous Equations

$X := 0$

$Y := 0$

$Z := 0$

Given

Note: Include an initial guess for the variables to be found.

Note: Begin the SOLVE BLOCK with the word GIVEN.

$3 \cdot X + 4 \cdot Y + 8 \cdot Z = 12$

$2 \cdot X - 7 \cdot Z = 13$

$-9 \cdot X + Y = -2 + 4 \cdot Z$

Note: List all contraints. Hold down the Ctrl key and press = to obtain the constraint symbol (Boolean equals) or pick the bold = on the toolbar .

$R := \text{Find}(X, Y, Z)$

Note: The SOLVE BLOCK must end with a Find statement.

$$R = \begin{bmatrix} 1.408 \\ 4.854 \\ -1.455 \end{bmatrix}$$

Note: Display the results.

Example 2: Simplifying Algebraic Equations

(Let MATHCAD do your algebra for you!)

$x := 0$

Given

$$3 \cdot x \cdot \sin\left(42 \cdot \frac{\pi}{180}\right) + \frac{17.6 \cdot x}{4.89} + (2 \cdot x - 72) \cdot 0.785 = 3.56 \cdot \pi - 1.25 \cdot 10^3$$

$Q := \text{Find}(x)$

$Q = -164.744$

Example 3: Solving Non-linear Equations

$x := 0$

Given

$14 \cdot e^{-2 \cdot x} + 3 \cdot \cos(6 \cdot x) = 21 \cdot x$ (Not an easy equation to solve!)

Answer := Find(x)

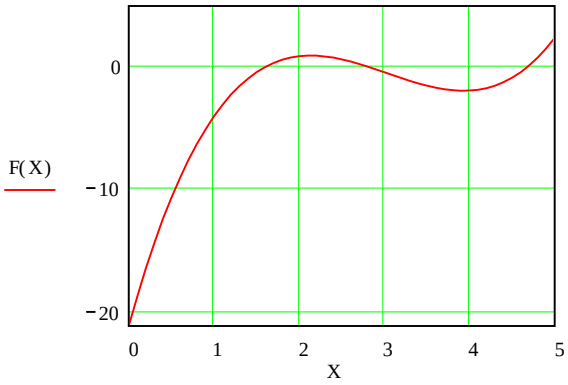
Answer = 0.313

Example 4: Finding Roots of Equations

Note: The function defined below should have 3 roots. A look at the graph will be helpful in making initial guesses.

$X := 0, .1 .. 5$

$F(X) := X^3 - 9.1 \cdot X^2 + 25.2 \cdot X - 21.1$



Note: It looks like the 1st root is between 1 and 2, the 2nd root is between 2 and 3, and the 3rd root is between 4 and 5.

$X := 1$ Note: A guess for finding the 1st root

Given

$X^3 - 9.1 \cdot X^2 + 25.2 \cdot X - 21.1 = 0$

Root1 := Find(X) Root1 = 1.595

$X := 3$ Note: A guess for finding the 2nd root

Given

$X^3 - 9.1 \cdot X^2 + 25.2 \cdot X - 21.1 = 0$

Root2 := Find(X) Root2 = 2.83

$X := 4$ Note: A guess for finding the 3rd root

Given

$X^3 - 9.1 \cdot X^2 + 25.2 \cdot X - 21.1 = 0$

Root3 := Find(X) Root3 = 4.675

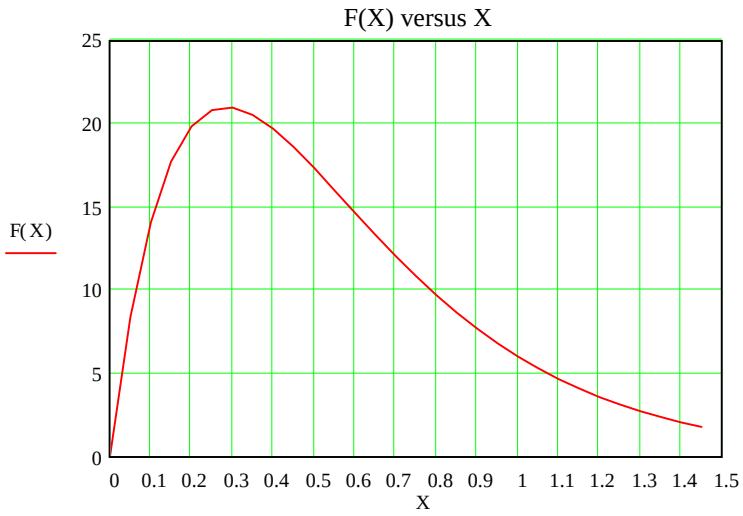
Example 5: Finding Maxima and Minima of functions

First graph the function below so that the maxima/minima features are clear. A look at the graph will be helpful in making initial guesses.

This gives 31 points for X to form a graph.

$X := 0, .05 .. 1.5$

$F(X) := 200 \cdot X \cdot e^{-3.5 \cdot X}$



We can see that the curve reaches a maximum somewhere between X = 0 and X = 0.5. We can use a SOLVE BLOCK to find the maximum. Recall that maxima and minima occur when the derivative equals 0.

$X := 0$

Note that F(X) was first defined above.

Given

$\frac{d}{dX} F(X) = 0$

$Xmax := Find(X)$

$Xmax = 0.286$

So the maximum occurs at X = 0.286 (this appears to agree with the graph above).

Now determine the value of F for Xmax.

$Fmax := F(Xmax)$

$Fmax = 21.022$

The maximum value of F (this appears to agree with the graph above).