**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**

\[
\begin{align*}
X & := 0 & \text{Note: Include an initial guess for the variables to be found.} \\
Y & := 0 \\
Z & := 0 \\
\text{Given} & \\
3 \cdot X + 4 \cdot Y + 8 \cdot Z & = 12 \\
2 \cdot X - 7 \cdot Z & = 13 \\
-9 \cdot X + Y & = 2 + 4 \cdot Z \\
R & := \text{Find}(X, Y, Z) \\
\begin{bmatrix}
1.408 \\
4.854 \\
-1.455
\end{bmatrix} & \text{Note: The SOLVE BLOCK must end with a Find statement.}
\end{align*}
\]

**Example 2: Simplifying Algebraic Equations**

(Let MATHCAD do your algebra for you!)

\[
\begin{align*}
x & := 0 \\
\text{Given} & \\
3 \cdot x \cdot \sin\left(42 \cdot \frac{\pi}{180}\right) & + \frac{17.6 \cdot x}{4.89} + (2 \cdot x - 72) \cdot 0.785 \equiv 3.56 \cdot \pi - 1.25 \cdot 10^3 \\
Q & := \text{Find}(x) \\
Q & = -164.744
\end{align*}
\]
**Example 3: Solving Non-linear Equations**

\[ x := 0 \]

Given
\[ 14 \cdot e^{-2x} + 3 \cdot \cos(6 \cdot x) - 21 \cdot x \]

(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.

\[ X := 0, 1, 2, 3, 4, 5 \]
\[ F(X) := X^3 - 9.1 \cdot X^2 + 25.2 \cdot X - 21.1 \]

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.

\[ X := 0, 0.05, 0.1, \ldots, 1.5 \]

\[ F(X) := 200Xe^{-3.5X} \]

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.

\[ X \text{max} \]

Given

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

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

\[ X \text{max} = 0.286 \]

\[ F \text{max} := F(X \text{max}) \]

Now determine the value of \( F \) for \( X \text{max} \).

\[ F \text{max} = 21.022 \]

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