Mathcad Summary

Basics

Toolbars
Equal signs: =, :=, **=**
Subscripts: "." vs "["
Greek letters: ctrl-g
Matrix: ctrl-m
Plot: @
Arrays start at 0, but change with ORIGIN:=1 or whatever
Evaluate: top to bottom and left to right
Units: Always work with K or R, never C, F, be careful when plotting.
Symbolic toolbar, versus symbolic menu

Integration

Define the function, then use the symbolic integral (calculus toolbar)

$$f(x) := 2x^2 + 1$$

$$\int_0^1 f(x)\,dx = 1.667$$

Curve Fitting

Polynomial

Use functions regress and interp

$$x := (0 \quad 1 \quad 2 \quad 3 \quad 4 \quad 5)^T$$

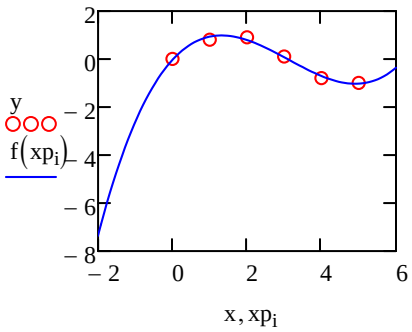
$$y := (0 \quad 0.8 \quad 0.9 \quad 0.1 \quad -0.8 \quad -1)^T$$

$$i := 0 .. 99$$

$$xp_i := i \cdot \frac{8}{99} - 2$$

$$p3 := regress(x, y, 3)$$

$$f(xp) := interp(p3, x, y, xp)$$



General fit

Use genfit function. Need to include partial derivatives

Fit given x, y data below to function: $f(x) = a \cdot \exp(-b \cdot x) + c$

$x := (0 \quad 0.41 \quad 0.82 \quad 1.22 \quad 1.63 \quad 2.04 \quad 2.44 \quad 2.86 \quad 3.26 \quad 3.67)^T$

$y := (3.14 \quad 2.0 \quad 1.29 \quad 1.34 \quad 0.55 \quad 0.77 \quad 0.45 \quad 0.65 \quad 0.29 \quad 0.58)^T$

$f(x, a, b, c) := a \cdot \exp(-b \cdot x) + c$

$$\frac{d}{da} f(xx, a, b, c) \rightarrow e^{-b \cdot xx}$$

$$\frac{d}{db} f(xx, a, b, c) \rightarrow -a \cdot xx \cdot e^{-b \cdot xx}$$

$$\frac{d}{dc} f(xx, a, b, c) \rightarrow 1$$

$$g(x, a) := \begin{pmatrix} a_0 \cdot \exp(-a_1 \cdot x) + a_2 \\ e^{-a_1 \cdot x} \\ -a_0 \cdot x \cdot e^{-a_1 \cdot x} \\ 1 \end{pmatrix}$$

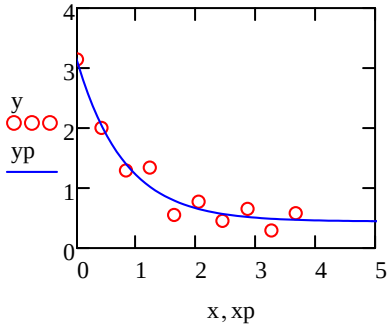
$$ag := \begin{pmatrix} 2 \\ 1 \\ 0.5 \end{pmatrix}$$

$$a := \text{genfit}(x, y, ag, g) \qquad a = \begin{pmatrix} 2.677 \\ 1.251 \\ 0.441 \end{pmatrix}$$

$$i := 0 .. 99$$

$$xp_i := i \cdot \frac{8}{99} - 2$$

$$yp := f\left(xp, a_0, a_1, a_2\right)$$



Interpolation

Use functions linterp (for linear interplation) adn cspline for cubic splines

Define the given x, y data points, and the x_interp points to interpolate to

$$i := 0 .. 9$$

$$x_i := i \cdot \frac{10}{9}$$

$$y := \cos\left[\frac{-(x)^2}{8}\right]$$

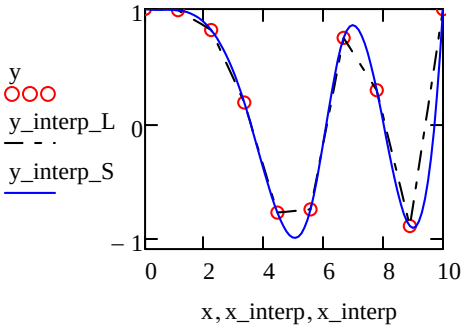
$$j := 0 .. 99$$

$$x\_interp_j := \frac{j \cdot 10}{99}$$

$$y\_interp\_L := \text{linterp}(x, y, x\_interp)$$

$$cs := \text{cspline}(x, y)$$

$$y\_interp\_S := \text{interp}(cs, x, y, x\_interp)$$



ODE System

Solve functions: $\frac{dv}{dt} = -9.81 + v^2$

$\frac{dx}{dt} = v$

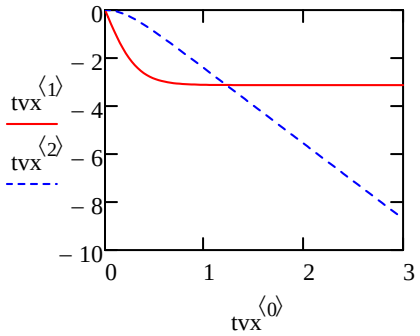
with initial condition $v0 = 0$ $x0 = 0$

$$y0 := \begin{pmatrix} 0 \\ 0 \end{pmatrix}$$

$$D(t, y) := \begin{bmatrix} -9.81 + (y_0)^2 \\ y_0 \end{bmatrix}$$

$tstart := 0$ $tend := 3$ $npts := 100$

$tvx := rkfixed(y0, tstart, tend, npts, D)$



System of Nonlinear Equations

Functions: root, polyroots, Given/Find block
Find a solution to the following two equations for y, z

$y = z^3 - 3z^2 + 5z + 3$

$z = z + 10$

$y := 1.0$

$z := 1.0$

Given

$y = z^3 - 3z^2 + 5z + 3$

$y = z + 10$

$\begin{pmatrix} y \\ z \end{pmatrix} := \text{Find}(y, z)$

$y = 12.516$

$z = 2.516$

System of Linear Equations

Find solution x for system Ax=b

$A := \begin{pmatrix} 1 & -2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix}$

$b := \begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix}$

$x := \text{lsolve}(A, b)$ or $x := A^{-1} \cdot b$

$x = \begin{pmatrix} -2.875 \\ 0.75 \\ 1.458 \end{pmatrix}$