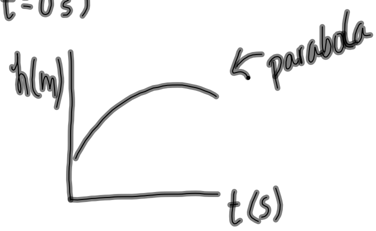
More Quadratic Applications

Example

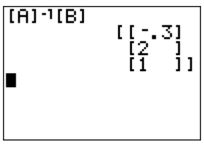
A softball is tossed so that its height above the ground (in metres) is:

1m when it is tossed ($t = 0s$)
y 2.7m when $t = 1s$ x
3.8m when $t = 2s$
4.3m when $t = 3s$



x y	$ax^2 + bx + c = y$		
$(0,1)$	$a(0)^2 + b(0) + c = 1$	$\Rightarrow$	$0a + 0b + c = 1$
$(1,2.7)$	$a(1)^2 + b(1) + c = 2.7$		$1a + 1b + c = 2.7$
$(2,3.8)$	$a(2)^2 + b(2) + c = 3.8$		$4a + 2b + c = 3.8$

$$\begin{bmatrix} 0 & 0 & 1 \\ 1 & 1 & 1 \\ 4 & 2 & 1 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 1 \\ 2.7 \\ 3.8 \end{bmatrix}$$



$AX = B$

$X = A^{-1}B$

$$\begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} -0.3 \\ 2 \\ 1 \end{bmatrix}$$

$y = ax^2 + bx + c$

$$\boxed{y = -0.3x^2 + 2x + 1}$$

How high (y) is the ball after 4s (x)?

$y = -0.3(4)^2 + 2(4) + 1$

$\boxed{y = 4.2m}$ The ball will be 4.2m above the ground after 4s

Example

The cost of television sets are related to their size by a quadratic relationship (approximate).

inches of diagonal	price
→ 6	152
→ 12	98
16	142
20	250
→ 30	800

When x is the size
y is the price.

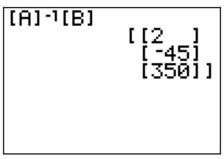
x y $\quad ax^2 + bx + c = y$

$(12, 98)\quad a(12)^2 + b(12) + c = 98 \Rightarrow 144a + 12b + c = 98$

$(30, 800)\quad a(30)^2 + b(30) + c = 800 \Rightarrow 900a + 30b + c = 800$

$(6, 152)\quad a(6)^2 + b(6) + c = 152 \Rightarrow 36a + 6b + c = 152$

$$\begin{bmatrix} 144 & 12 & 1 \\ 900 & 30 & 1 \\ 36 & 6 & 1 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 98 \\ 800 \\ 152 \end{bmatrix}$$



$AX = B$

$X = A^{-1}B$

$$\begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 2 \\ -45 \\ 350 \end{bmatrix}$$

$y = ax^2 + bx + c$

$$\boxed{y = 2x^2 - 45x + 350}$$

What is the cost of a 52" TV using this model?

$y = 2(52)^2 - 45(52) + 350$

$y = \$3418$