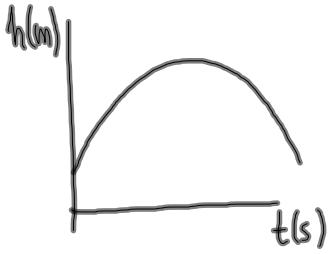
More Quadratic Applications

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

- 1m at t=0s
- 2.7m at t=1s
- 3.8m at t=2s
- 4.3m at t=3s



The softball's path can be modelled with a quadratic equation ($y=ax^2+bx+c$). Find the specific equation related the height (h) to the time (t).

t h

$(0,1)$ $a(0)^2+b(0)+c=1 \Rightarrow 0a+0b+c=1$

$(1,2.7)$ $a(1^2)+b(1)+c=2.7 \Rightarrow 1a+1b+c=2.7$

$(2,3.8)$ $a(2^2)+b(2)+c=3.8 \Rightarrow 4a+2b+c=3.8$

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

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[A]^-1[B]
          [[-.3]
           [2  ]
           [1  ]]
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$AX=B$

$X=A^{-1}B$

$$X=\begin{bmatrix} -0.3 \\ 2 \\ 1 \end{bmatrix}$$

$\therefore a=-0.3, b=2, c=1$

Equation for the softball $\rightarrow$ $y=-0.3x^2+2x+1$

OR $h=-0.3t^2+2t+1$

What would the height be at 4s?

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

$h=4.2m$

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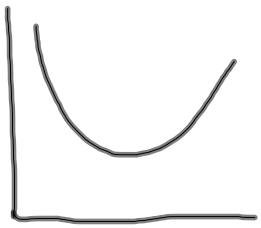
Example

The cost of TV sets are related to their size by a quadratic relationship (approximately):

Inches diagonal	cost
* 6	152
* 12	98
16	142
20	250
* 30	800



$y = ax^2 + bx + c$

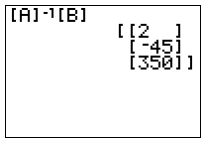
x y

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

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

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

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



$AX = B$

$X = A^{-1}B$

$$X = \begin{bmatrix} 2 \\ -45 \\ 350 \end{bmatrix}$$

$\therefore a = 2, b = -45, c = 350$

The equation: $y = 2x^2 - 45x + 350$

Now: find the cost of a 52 inch TV:

$y = 2x^2 - 45x + 350$

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

$y = \$3418$

↑ the cost of a 52 inch TV