

Chapter 6 / Example 5

Quadratic modelling

There are two methods you can use to do this.

A student wants to model the path of a rock with respect to time.

He is standing at the top of a vertical cliff at a height of 20 m and throws a rock upwards as shown in the diagram.

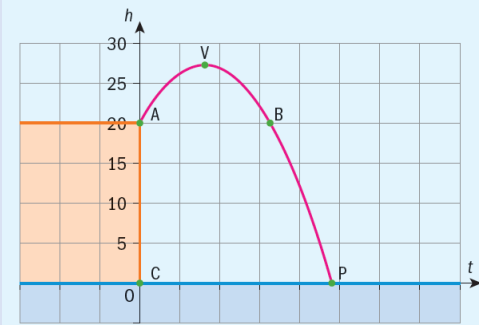
He starts counting time at the instant he throws the rock, at point A.

He measures that the time at which the rock is again at eye level, at point B, is $t = 3.26$ s.

He finally measures that the time at which the rock falls into the sea, at point P, is $t = 4.8$ s.

The function that will model the height of the rock with respect to time is a quadratic function of the form $h(t) = at^2 + bt + c$.

Find the equation of the function that will model the height h of the ball at time t .



Method 1: Using Quadratic regression

You need to identify three clear points on the curve. Known points are A(0, 20), B(3.26, 20) and P(4.8, 0).

Open a new document and add a Lists & Spreadsheet page.

Type 'x' in the first cell.

Enter the x-coordinates in the first column.

Press **enter** or **▼** after each number to move to the next cell.

Note: 'x' is a label that will be used to calculate the regression equation. You can use any letter or name to label the list.

A	x	B	C	D
=				
1	0			
2	3.26			
3	4.8			
4				
5				
A#				

Type 'y' in the cell to the right of 'x'.

Enter the number of kilometres the car travelled on one litre of diesel in the second column.

Use the **▲ ▼ ► ◀** keys on the touchpad to navigate the spreadsheet.

A	x	B	y	C	D
=					
1	0	20			
2	3.26	20			
3	4.8	0			
4					
5					
B#					

Chapter 6 / Example 5

Quadratic modelling

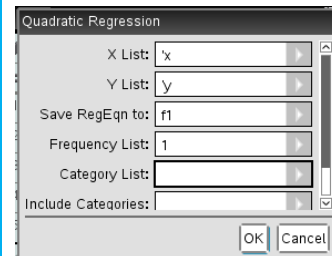
To calculate the equation of quadratic regression

Press **menu** 4:Statistics | 1:Stat Calculations | 6:Quadratic Regression...

Open the drop down lists with **▶** and select using **▼** and **enter**

Choose 'x' for X List and 'y' for Y List and leave the remaining fields unchanged.

Click the touchpad on OK or press **enter**



The parabola is given by the equation

$$h(t) = -2.71t^2 + 8.82t + 20.$$

A	x	B	y	C	D
=					=QuadRe
1	0	20	Title	Quadrat...	
2	3.26	20	RegEqn	a*x^2+b...	
3	4.8	0	a	-2.70563	
4			b	8.82035	
5			c	20.	
D1="Quadratic Regression"					

Method 2: Using **Simultaneous equation solver**.

Curve passes through (0, 20), (3.26, 20) and (4.8, 0) as above.

Substituting these points into the general equation of a parabola, $y = ax^2 + bx + c$.

$$a(0)^2 + b(0) + c = 20$$

$$a(3.26)^2 + b(3.26) + c = 20$$

$$a(4.8)^2 + b(4.8) + c = 0$$

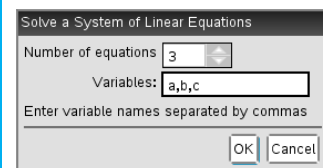
Add a new Calculator page to your document by pressing

ctrl **doc** **(+page)** 1:Add Calculator.

Press **menu** 3:Algebra | 2:Solve System of Linear Equations...

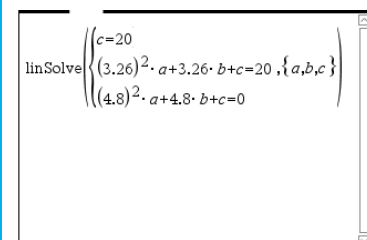
Select 3 equations and enter the variables a,b,c separated by commas.

Click the touchpad on OK or press **enter**.



Enter the three equations.

Press **enter**.

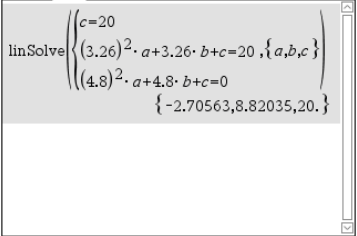


Chapter 6 / **Example 5**

Quadratic modelling

The parabola is given by the equation

$$h(t) = -2.71t^2 + 8.82t + 20.$$



$$\text{linSolve}\left(\left\{\begin{array}{l} c=20 \\ (3.26)^2 \cdot a + 3.26 \cdot b + c = 20 \\ (4.8)^2 \cdot a + 4.8 \cdot b + c = 0 \end{array}\right\}, \{a, b, c\}\right)$$

$$\{-2.70563, 8.82035, 20.\}$$