

Chapter 8 / Example 4

Sinusoidal regression

For the function $f(x) = a\sin(b(x + c)) + d$, the graph of $y = f(x)$ is drawn. The first maximum point shown has coordinates (1, 2) and the first minimum point has coordinates (5, -8).

- State the equation of the principal axis.
- Hence find the value of d .
- Find the amplitude of the function.
- Hence find the value of a .
- Find the period of the function.
- Hence find the value of b .
- By considering the effect of the horizontal stretch on the first maximum point of $y = \sin x$ find the value of c .
- State the values of $f(x)$ for $x = 0, 1, 5, 8, 9$ and use those data points to verify a sinusoidal regression calculation on your GDC gives the same result.

The principal axis is $y = -3$. $d = -3$.

The amplitude is 5. $a = 5$.

The period is 8. $b = \frac{\pi}{4}$.

$c = 1$.

The equation is $f(x) = 5\sin\left(\frac{\pi}{4}(x + 1)\right) - 3$.

$$f(0) = f(8) = 5\sin\left(\frac{\pi}{4}\right) - 3.$$

$$f(1) = f(9) = 2 \text{ and } f(5) = -8.$$

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 | B | C | D |
|---|---|---|---|---|
| 1 | x | | | |
| 2 | 0 | | | |
| 3 | 1 | | | |
| 4 | 5 | | | |
| 5 | 8 | | | |
| 6 | 9 | | | |

Chapter 8 / Example 4

Sinusoidal regression

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

Enter the y -coordinates in the second column.

Use the \blacktriangle \blacktriangledown \blacktriangleright \blacktriangleleft keys on the touchpad to navigate the spreadsheet.

| A | x | B | y | C | D |
|---|---|---|-----------------|----|---|
| 1 | 0 | 5 | $\sin(\pi/4)-3$ | | |
| 2 | 1 | | | 2 | |
| 3 | 5 | | | -8 | |
| 4 | 8 | 5 | $\sin(\pi/4)-3$ | | |
| 5 | 9 | | | 2 | |

To calculate the equation of sinusoidal regression

Press $\boxed{\text{menu}}$ 4:Statistics | 1:Stat Calculations | C:Sinusoidal Regression...

Open the drop-down lists with \blacktriangleright and select using \blacktriangledown and $\boxed{\text{enter}}$ $\boxed{\text{del}}$

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

Click the touchpad on OK or press $\boxed{\text{enter}}$ $\boxed{\text{del}}$

Sinusoidal Regression

X List: \boxed{x}

Y List: \boxed{y}

Save RegEqn to: $\boxed{f1}$

Iterations: $\boxed{8}$

Period: $\boxed{(\text{optional})}$

Category List: $\boxed{}$

$\boxed{\text{OK}}$ $\boxed{\text{Cancel}}$

The equation of the curve is given by the equation

$$f(x) = 5 \sin(0.785x + 0.785) - 3.$$

Note that $\frac{\pi}{4} = 0.785$.

The equations are the same.

| A | B | C | D |
|---|-----------|--------|--------------------------|
| 1 | | | $=\text{SinReg}(x,y,8):$ |
| 2 | 2 | RegEqn | $a*\sin(b*x+c)+d$ |
| 3 | -8 | a | 5. |
| 4 | $\pi/4-3$ | b | 0.785398 |
| 5 | 2 | c | 0.785398 |
| 6 | | d | -3. |