# 6.4 - Modelling Data with a Curve of Best Fit

Monday, December 6, 2021 10:08 AM

6.4 - Modelling...



**6.4 – MODELLING DATA WITH A CURVE OF BEST FIT**

*Curve of best fit*

Curve of best fit is a curve that best approximates the trend on a scatter plot.

*Use Technology to Solve a Quadratic Problem*

*Example 1*: The concentration (in milligrams per litre) of a medication in a patient's blood is measured as time passes. Susan has collected the following data and is attempting to express the concentration as a polynomial function of time.

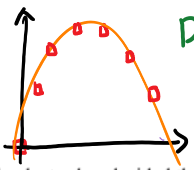
Stat → Edit

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_1$ | Time (*T hours*) | 0 | 1.5 | 3 | 4.5 | 6 | 7.5 | 9 |
| $L_2$ | Concentration (*C* mg/L) | 0 | 26.9 | 41.2 | 47.8 | 46.0 | 36.8 | 20.3 |

Zoom Stat

Var → Y-Var → Function

a. On a graphing calculator, enter the data in two lists. Time in $L_1$ and Concentration in $L_2$. Create a scatter plot of the data and use the quadratic regression feature to determine the polynomial function, $C = aT^2 + bT + c$, that best fits the data. Round the parameters *a*, *b*, and *c* to 2 decimal places.

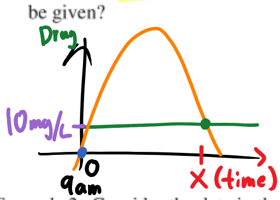


Deg 2 Stat → Calc → Quad Reg $L_1, L_2, Y_1$

$$\boxed{y = -1.86x^2 + 18.76x + 1.21}$$

→ 0.6 of a hour ⇒ 0.6 × 60 min = 36 min

b. The doctor has decided that the patient needs a second dose of medication when the concentration in the blood is less than 10 mg/L. If the first dose of medication was given at 9:00am, at what time should the second dose be given?




$\boxed{Y_2 = 10}$

$x = ?$

$x = 9.6$ hr after 1st dose.

↳ 6pm : 36 min → $\boxed{6{:}36\text{ pm}}$

2nd | Trace → Intersect → Enter ×3

Calc

*Example 2*: Consider the data in the table. Use technology to create a scatter plot and to determine the equation of the line of best fit.

Quad Reg $L_1, L_2, Y_1$ $y = 0.74x^2 - 7.12x + 19.23$

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *x* | 0 | 1.5 | 3.3 | 5.1 | 7.4 | 8.6 | 10.0 |
| *y* | 19.5 | 10.3 | 3.4 | 1.6 | 6.2 | 16.1 | 20.3 |

a. Determine, to the nearest tenth, the value of *y* when *x* is 10.6.

2nd → Cal → Value.

$X = 10.6$

$Y = 26.95?$

b. Determine, to the nearest tenth, the value of *x* when *y* is 9.8

2nd → Cal → Intersect.

$Y_2 = 9.8$

$X_1 = 1.59$ $X_2 = 8.03$

Technology uses polynomial regression to determine the curve of best fit. Polynomial regression results in an equation of a curve that balances the points on both sides of the curve. A curve of best fit can be used to predict values that are not recorded or plotted. Predictions can be made by reading values from the curve of best fit on a scatter plot or by using the equation of the curve of best fit.

*Use Technology to Solve a Cubic Regression Function*

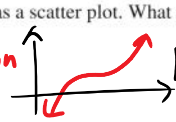
*Example 3*: The following table shows the average retail price of gasoline, per litre, for a selection of years in a 30-year period beginning in 1979.

L1 L2

| Years after 1979 | Price of Gas (¢/L) | Years after 1979 | Price of Gas (¢/L) |
|---|---|---|---|
| 1979 0 | 21.98 | 17 | 58.52 |
| 1980 1 | 26.18 | 20 | 59.43 |
| 2 | 35.63 | 22 | 70.56 |
| 3 | 43.26 | 23 | 70.00 |
| 4 | 45.92 | 24 | 74.48 |
| 7 | 45.78 | 25 | 82.32 |
| 8 | 47.95 | 26 | 92.82 |
| 9 | 47.53 | 27 | 97.86 |
| 12 | 57.05 | 28 | 102.27 |
| 14 | 54.18 | 29 | 115.29 |

Statistics Canada

a. Use technology to graph the data as a scatter plot. What polynomial function could be used to model the data? Explain.

Cubic function  positive

$y = 0.0123x^3 - 0.465x^2 + 6.295x + 23.452$

Stat → Calc → 6: CubicReg L1, L2, Y1

b. Determine the cubic regression equation that models the data. Use your equation to estimate the average price of gas in 1984 and 1985.

Value

1984 − 1979 = 5 X = 5 y = \$ 44.85

1985 − 1978 = 6 X = 6 y = \$ 47.15

c. Estimate the year in which the average price of gas was 56.0¢/L.

$\boxed{Y_2 = 56}$ X = 16.5 ≈ 16 years after 1979

Intersect

Year

1979 → $\boxed{1995}$

$\boxed{\text{Try}}$

5. Consider the data in the table. Create a scatter plot from the data using a graphing calculator.

| $x$ | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $y$ | 120 | 102 | 83 | 74 | 67 | 64 | 62 | 54 | 45 | 31 | 10 |

a. Use the cubic regression feature of a calculator to determine a cubic function that models the data. Round to three decimal places.

$y = -0.00234x^3 + 0.178x^2 - 5.275x + 121.301$

b. Use the cubic regression equation to determine the value of x when y = 90.

$Y_2 = 90 \rightarrow X = 7.758$

c. Use the linear regression feature of a calculator to determine a ~~linear~~ Linear function that models the data. Round to three decimal places.

$y = -1.805x + 109.864$

d. Use the linear regression equation to determine the value of x when y = 90.

$Y_2 = 90 \rightarrow X = 11.002$

e. Which model appears to be the better for the data?

Cubic Regression ; Smaller Errors.