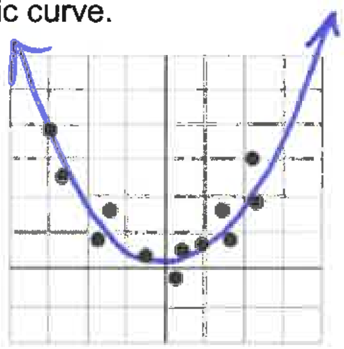
6.4 – Modelling Data with a Curve of Best Fit

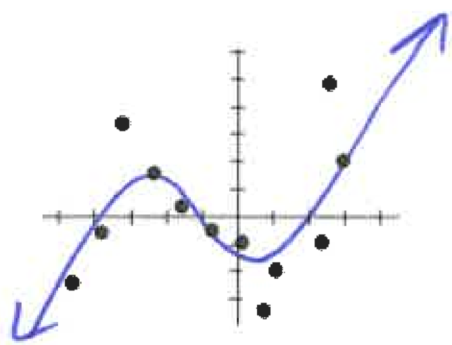
Date: APRIL. 18

Definitions:

- **Curve of best fit:** A curve that best approximates the trend on a scatter plot.
- **Regression function:** A line or curve of best fit, developed through a statistical analysis of data.

There are two main curves that can be used to find a curve of best fit: a quadratic curve, and a cubic curve.





Using Technology to Solve a Quadratic Problem

Example: The following table gives the value of a company's stock since the beginning of 2018. The first column is the number of months since the start of 2018, and the second column is the value of the stock at that time.

Months (L_1, x)	Price (L_2, y)
0	454
2	516
4	700
9	663
11	582
15	405

a) Plot a scatter plot for the data, find a regression function, and graph the curve of best fit. (quadratic)

$y = \underset{a}{-4.659}x^2 + \underset{b}{66.027}x + \underset{c}{449.243}$

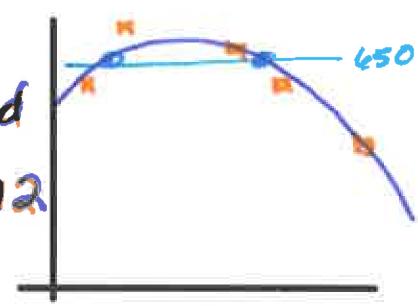
b) Use your regression equation to compare the stock after 3 months with the stock after 12 months.

2nd TRACE 1: value

$X = 3 \rightarrow Y = \$ 605.39$

$X = 12 \rightarrow Y = \$ 570.67$

price dropped by \$34.72



c) Determine when was the optimum time to sell the stock to maximize profits.

2nd TRACE 4: maximum

max. at $X = 7.1 \rightarrow$ sell early in August.

d) If you were willing to sell if the value of the stock was above \$650, when would you be willing to sell?

2nd TRACE 5: intersect

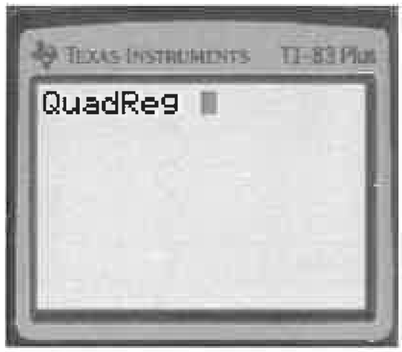
PLOT $Y = 650$ and find intersections

$X = 4.42$, $X = 9.75$ } sell between mid-May and late October

Finding the Equation of Best Fit

Estimate the function of the data. The above data appears to be quadratic, so we will use a quadratic formula to approximate our data. This is the form $y = ax^2 + bx + c$.

Press STAT, and move the cursor over to CALC. Select option 5:QuadReg, and the calculator will return to the main screen showing QuadReg. For a cubic function, select 6:CubicReg. Press Enter.

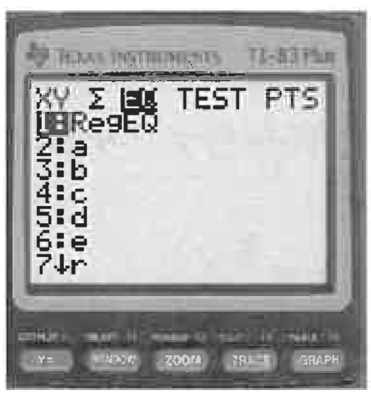


The calculator gives the values for a and b, so you can write your equation as:

$$y = -4.6590x^2 + 66.0274x + 449.24$$

Graphing the Curve of Best Fit

Press Y= to bring up the screen for functions. Press VARS and select 5:Statistics. Move over to the EQ heading and select 1:RegEQ. The calculator will enter the Linear Regression equation you just solved. Press Graph.



You should now have your data points and the curve of best fit graphed. Use 2nd and CALC to solve for a value, or use the TRACE button to trace the curve of best fit to find a point on the curve.

If you want to find when the curve crosses a particular y-value, plot y = constant (whatever value you want), and graph. Then use 2nd and CALC to find the point(s) of intersection by selecting 5:intersect.

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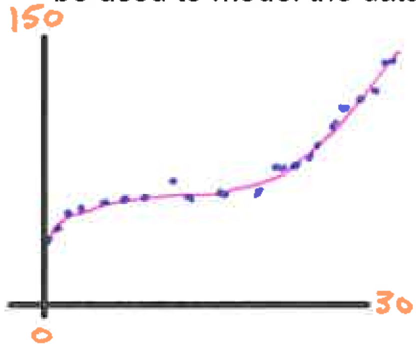
Example: The following table shows the average retail price of gasoline, per litre, for a selection of years in a 30-year period beginning in 1979.

L1 Years after 1979	L2 Price of Gas (₵/L)	L1 (CON'T) Years after 1979	L2 (CON'T) Price of Gas (₵/L)
0	21.98	17	58.52
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

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



$\boxed{\text{cubic}}$ $\Rightarrow$

we have 2 bends

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

$$\boxed{y = \underset{a}{0.0123}x^3 - \underset{b}{0.4645}x^2 + \underset{c}{6.2950}x + \underset{d}{23.4516}}$$

$\boxed{\text{2nd}}\boxed{\text{TRACE}}$ 1: value

1984 $(x=5)$: 44.85 ¢/L 1985 $(x=6)$: 47.15 ¢/L

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

graph $Y=56$ $\rightarrow$ intersection at $X=16.5$

$\boxed{\text{2nd}}\boxed{\text{TRACE}}$ 5: intersect

$1979 + 16.5 = 1995.5$

$\boxed{\text{middle of 1995}}$