We can use differences to determine the degree of a function when the sample domain elements are evenly spaced.

1. If the 1st Differences are the same, then the relation is linear.
2. If the 2nd Differences are the same, then the relation is quadratic.
3. If the 3rd Differences are the same, then the relation is cubic.

   And so on …

x	-3	-1	1	3	5
y	-25	-17	-9	-1	7

8 8 8 8

1st Differences are equal → Linear Function

x	-3	-1	1	3	5
y	19	5	-1	1	11

-14 -6 2 10

8 8 8

2nd Differences are equal → Quadratic Function

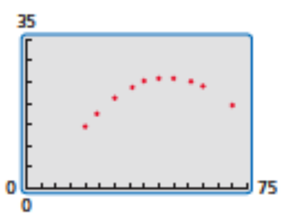
Miles per hour, *x*	Miles per gallon, *y*
20	14.5
24	17.5
30	21.2
36	23.7
40	25.2
45	25.8
50	25.8
56	25.1
60	24.0
70	19.5

The table shows fuel efficiencies of a vehicle at different speeds. Write a function that models the data. Use the model to approximate the optimal driving speed.

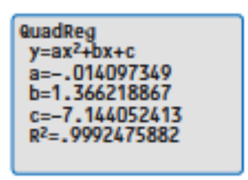
SOLUTION

Because the x-values are not equally spaced, you cannot analyze the differences in the outputs. Use a graphing calculator to find a function that models the data.

Step 1 Enter the data in a graphing calculator using two lists and create a scatter plot. The data show a quadratic relationship.

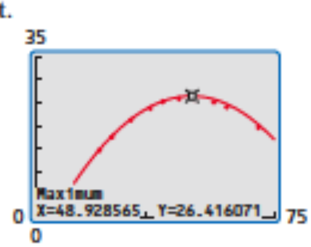


Step 2 Use the *quadratic regression* feature. A quadratic model that represents the data is $y = -0.014x^2 + 1.37x - 7.1$.



Step 3 Graph the regression equation with the scatter plot.

In this context, the "optimal" driving speed is the speed at which the mileage per gallon is maximized. Using the *maximum* feature, you can see that the maximum mileage per gallon is about 26.4 miles per gallon when driving about 48.9 miles per hour.



▶ So, the optimal driving speed is about 49 miles per hour.

The table shows the heights *h* in feet of a wrench *t* seconds after it has been dropped from a building under construction.

Time, *t*	0	1	2	3	4
Height, *h*	400	384	336	256	144

1. Use the calculator to Write the Equation that fits the data in the table.
2. Use the calculated equation to find the height of the wrench at 1.379 Seconds.

Solution:
Use the Stat Function to create the following Lists:

L1	L2	L3 2
0	400	------
1	384	
2	336	
3	256	
4	144	

L2(6) =

Calculate the *Quadrtic* Regression, and input the result into Y1.

```
QuadReg Y1
```

```
QuadReg
 y=ax²+bx+c
 a=-16
 b=0
 c=400
 R²=1
```

When $R^2 = 1$, the Correlation is Perfect.

The equation is $f(x) = -16x^2 + 0x + 400$

The Height at t = 1.379 Seconds is 369.573744.

The table shows the height of a ball after it has been kicked. Write a function that models the data. Approximate the height of the ball after 6.7 seconds.

Time, *x*	1	2	3	4	5
Height of ball, *y*	12.7	15.2	14.9	13.1	10.4

Check your answers with the following:
$y = -0.85x^2 + 4.43x + 9.32$
Height = 0.8445 feet

Assignment 122

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