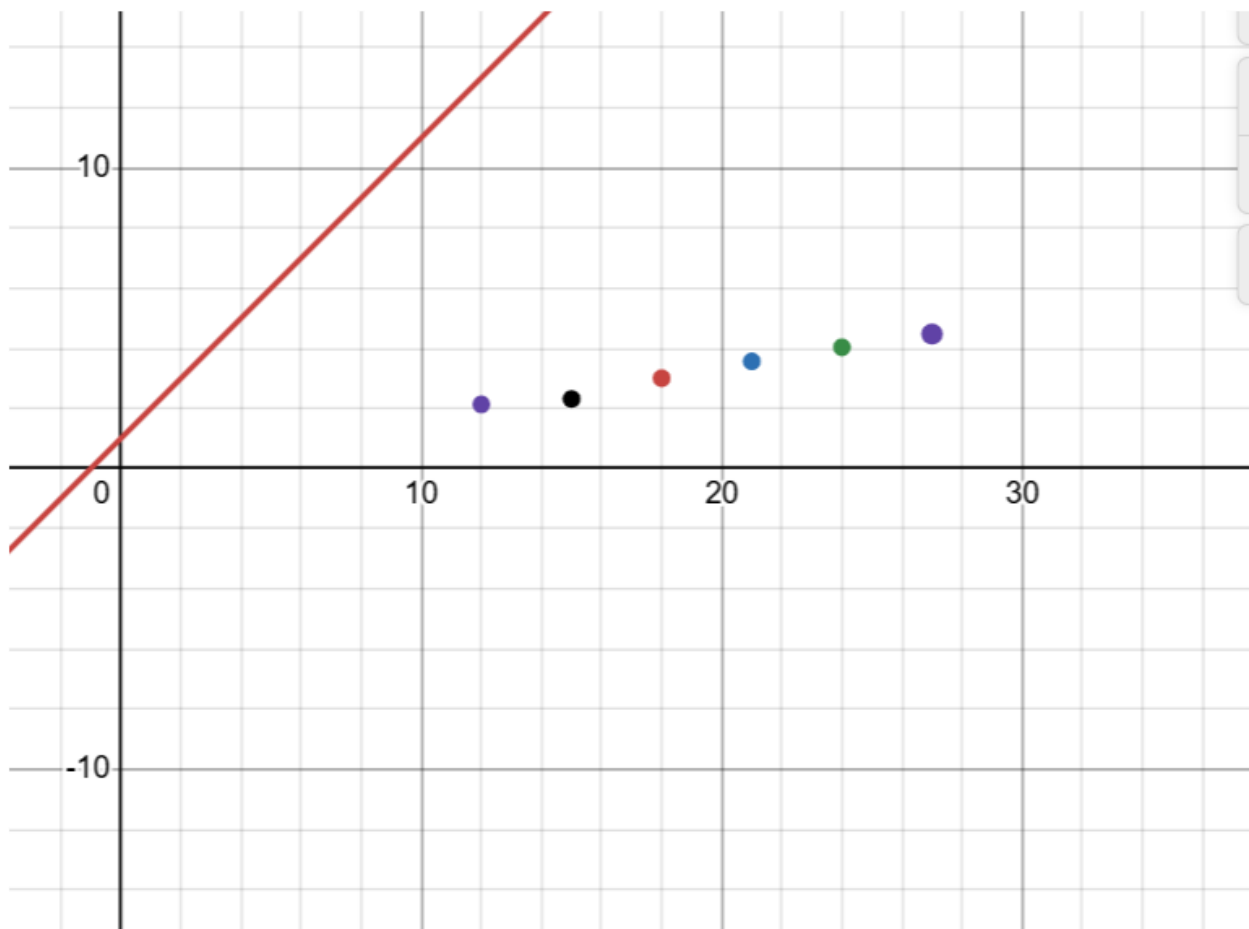


## ACTIVITY 01 (Muhammad Anas)

The x and y points are  $x = [12, 15, 18, 21, 24, 27]$

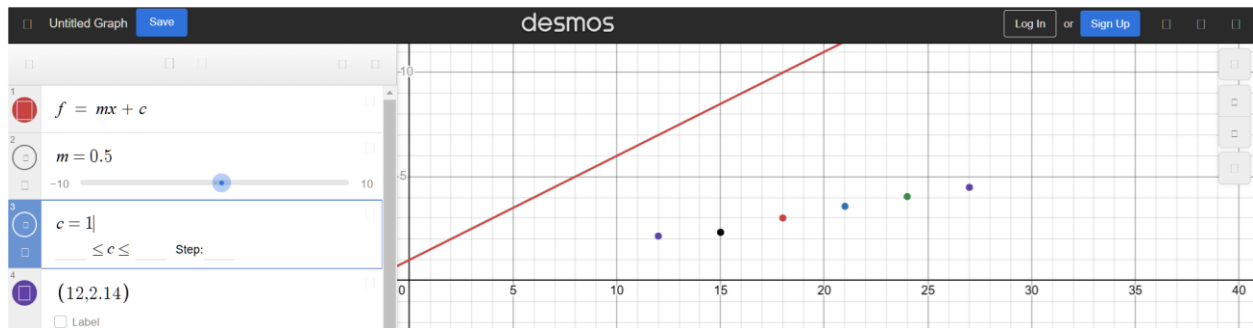
$y = [2.14, 2.32, 3.01, 3.57, 4.04, 4.48]$

**Plot the above points and an equation of function  $y = mx + c$  using online plotting tool.**

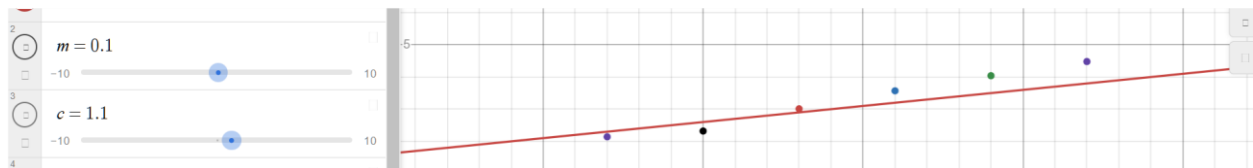


When we tweak the slope from 1 to 0.5 to be more inclined towards the points :

Then we observe slightly better approximation:



Clearly we need to decrease the y-intercept and slope few points so the line better coincides with the above dots, when after observing different values try with  $m = 0.1$  and  $c = 1.1$  I get  $\text{loss}(F) =$



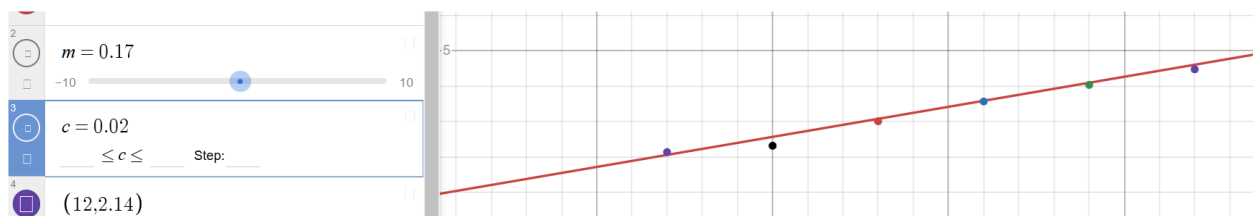
①

now When  $m = 0.1$ ,  $c = 1.1$  then

$$F = (2.3 - 2.14)^2 + (2.6 - 2.32)^2 + (2.9 - 3.01)^2 + (3.2 - 3.57)^2 + (3.5 - 4.04)^2 + (3.8 - 4.48)^2$$

$F = 1.007$

Now tweaking down the y-intercept we get a better approximation:



When  $m = 0.17$  &  $c = 0.02$

$$F = \frac{(2.06 - 2.14)^2 + (2.57 - 2.32)^2 + (3.08 - 3.01)^2 + (3.59 - 3.57)^2}{2((4.01 - 4.04)^2 + (4.61 - 4.48)^2)}$$

$$F = 0.0947$$

Which is a better approximation

We can also confirm our loss functions output by determining the optimized values of  $m$  and  $c$  using the Regression Coefficients formula:

Using formula of Regression Coefficients:

$$Y = ax + b \quad \text{then}$$
$$a = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2}$$

$$b = \frac{(\sum y)(\sum x^2) - (\sum x)(\sum xy)}{n(\sum x^2) - (\sum x)^2}$$

$$F = \phi_0 x + \phi_1$$

$$\phi_0 = \frac{\sum_{i=1}^n x_i y_i - \frac{\sum_{i=1}^n x_i \cdot \sum_{i=1}^n y_i}{n}}{\sum_{i=1}^n x_i^2 - \frac{(\sum_{i=1}^n x_i)^2}{n}} \quad (i)$$

$$\phi_1 = \frac{(\sum_{i=1}^n y_i) \left( \sum_{i=1}^n x_i^2 \right) - \left( \sum_{i=1}^n x_i \right) \left( \sum_{i=1}^n x_i y_i \right)}{\sum_{i=1}^n x_i^2 - \frac{(\sum_{i=1}^n x_i)^2}{n}} \quad (ii)$$

$$\sum y = 19.56, \quad \sum x = 117, \quad \sum xy = 407.55$$

$$\sum x^2 = 2439, \quad \left( \sum x \right)^2 = 13689,$$

$$\phi_0 = \frac{6(407.55) - (117)(19.56)}{6(2439) - 13689}$$

$$\phi_0 = 0.166$$

$$\text{Similarly } \phi_1 = 0.02$$

$$\text{So Cost } F_n \text{ is } F = 0.166x + 0.02$$

$$\text{Now } \sum_{i=1}^n \left[ (0.166x_i + 0.02) - y_i \right]^2$$

$$= (2.012 - 2.14)^2 + (2.51 - 2.32)^2 + (3.008 - 3.01)^2 \\ + (3.506 - 3.57)^2 + (4.004 - 4.04)^2 + (4.502 - 4.46)^2$$

$$= 0.016 + 0.0361 + 4 \times 10^{-6} + 4.096 \times 10^{-3} + 1.089 \times 10^{-2} + 4.5 \times 10^{-3}$$

05

Date 20

$$= 0.0577$$

Error Amount.

①