



Hours of sunlight

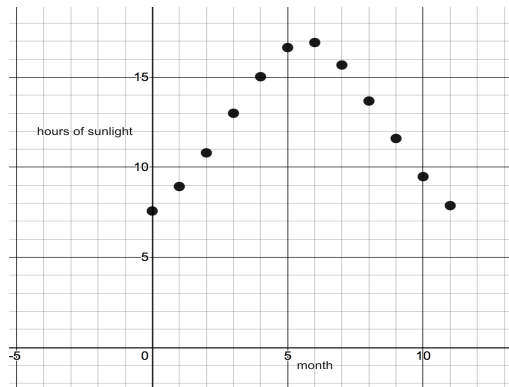
The following is data on the hours of sunlight on the first of each month. 0 represents January 1st and 1 represents February 1st etc.

Manchester

0	1	2	3	4	5	6	7	8	9	10	11
7.57	8.93	10.8	13	15.03	16.65	16.93	15.68	13.68	11.6	9.48	7.87

<https://www.timeanddate.com/sun/uk/manchester>

- (1) Plot your points in Desmos. Label your axes. Your graphs should look something like this:



- (b) For the Manchester graph we can try and fit a cosine curve of the form:

$$h(t) = -a \cos(bt) + d$$

- (i) Find a by the following calculation:

$$|a| = \frac{\text{max} - \text{min}}{2}$$

- (ii) Explain what the negative in front of the a does.

- (iii) Use the following calculation to work out b

$$\text{period} = \frac{360}{b}$$

- (iv) Find d by finding the equation of the principal axis ($y = d$).

- (v) Plot your equation on Desmos (make sure your graph is set to degrees). Comment on the accuracy of your model.



The equivalent data for Phuket is shown below:

Phuket

0	1	2	3	4	5	6	7	8	9	10	11
11.7	11.93	11.97	12.18	12.38	12.53	12.57	12.45	12.25	12.05	11.83	11.7

<https://www.timeanddate.com/sun/thailand/phuket>

- (2) Plot your points on Desmos
- (b) Follow the same steps as in (1) to find an equation for the hours of sunlight in Phuket in the form:

$$h(t) = -a\cos(bt) + d$$

- (ii) Comment on the accuracy of your model. Compare the 2 models for Phuket and Manchester. What are the similarities? What are the differences?
- (3) Use the trigonometric regression on Desmos to find a model for both Phuket and Manchester. Comment on the R^2 values. How similar were your models to the Desmos model?
- (4) Use your Desmos regression models to answer the following:
- (i) On what dates do Manchester and Phuket have the same hours of sunlight?
- (ii) By considering the two principal axes, decide which location has the higher average hours of sunlight.
- (iii) For how many days of the year does Manchester have more than 15 hours of sunlight a day?
- (5) What factor determines hours of sunlight? How would you expect the graph for hours of sunlight in Antarctica to look like? Can you find out this data to check your hypothesis?