College Algebra, Section 2.2, #34
Fitting Lines to Data Points: Modeling Linear Functions

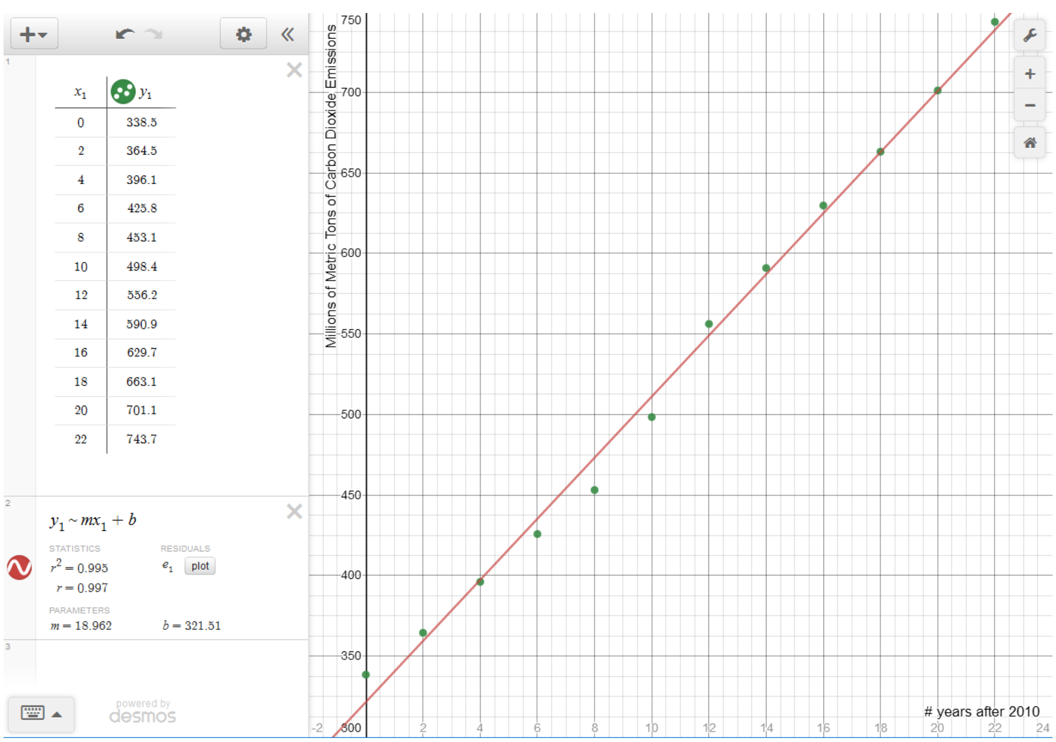
Carbon Dioxide Emissions *The table gives the millions of netric tons of carbon dioxide emissions from biomass energy combustion in the United States for selected years from 2010 projected to 2032.*[1]

Year	CO_2 Emissions (millions of metric tons)
2010	338.5
2012	364.5
2014	396.1
2016	425.8
2018	453.1
2020	498.4
2022	556.2
2024	590.9
2026	629.7
2028	663.1
2030	701.1
2032	743.7

(Source: U.S. Department of Energy)

a. *Find a linear function that gives the millions of metric tons of carbon dioxide emissions, y, as a function of x, the number of years after 2010.*

The first step is to enter the data correctly into our graphing utility. Notice that x is the number of years AFTER 2010. This means that $x = 0$ for the year is 2010, $x = 2$ for the year 2012, and so forth. Look at the x-values below to see how I entered the data.



[1]Harshbarger/Yocco, *College Algebra In Context*, 5e, p. 121, #34.

Then I used my graphing utility to find the line of best fit.

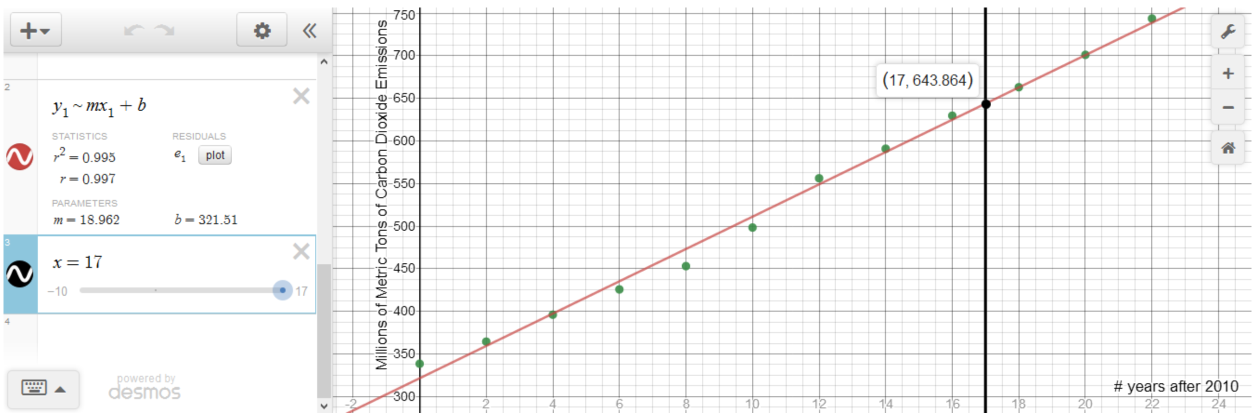
The equation for this line is $y = 18.962x + 321.51$

b. *Graph the model on the same axes with the data. Is it a good fit for the data?*

Look again at the graph above. Though the line doesn't exactly fit the data, we can say that it is a good approximation or "good fit".

This "good fit" is verified by the value of the correlation coefficient, $r = 0.997$. (Recall, r is a number between 0 and 1 where $r = 1$ signals a perfect fit.)

c. *What does the (unrounded) model predict the millions of metric tons of carbon dioxide emissions will be in 2027?*



In 2017, $x = 17$. So we look for the point on the line of best fit that has an x-coordinate of 17. This point is $(17, 643.864)$.

The model predicts that in 2027 there will be 643.9 millions of metric tons of carbon dioxide emissions.

We could also answer this question algebraically using the equation for the line of best fit and letting $x = 17$.

$$\begin{aligned} y &= 18.962x + 321.51 \\ &= 18.962(17) + 321.51 \\ &= 322.354 + 321.51 \\ &= 643.864 \end{aligned}$$

Again, the model predicts that in 2027 there will be 643.9 millions of metric tons of carbon dioxide emissions.

d. *When will the millions of metric tons of carbon dioxide emissions reach 776.6, according to the model?*

In this question we're asked to find an x-value when a y-value is given. And, again, we can find the answer either graphically or algebraically.

I'll start with the graphical method letting $y = 776.6$ and looking for the intersection between this horizontal line and the line of best fit that we found in part a.

The point point of intersection is $(24, 776.6)$.

The model predicts that 776.6 million metric tons of carbon dioxide emissions will be emitted in 2034 (which is 24 years after 2010).

If you want to answer this question algebraically, let $y = 776.6$ and solve for x.

$$\begin{aligned} y &= 18.962x + 321.51 \\ 776.6 &= 18.962x + 321.51 \\ 455.09 &= 18.962x \\ 24.0 &= x \end{aligned}$$

Again, the model predicts that 776.6 million metric tons of carbon dioxide emissions will be emitted in 2034.