

FITTING CURVES TO SCATTERPLOTS

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Most measurable data collected has some amount of error involved because our instruments are not precise. Data that is actually linear, quadratic, or exponential will follow a general pattern, but the data points only approximate the normal equations. When these data points are graphed it creates what is called a **scatterplot**. Once the points are graphed and the general shape of the graph has been determined, a curve that best approximates the trend of the data may be drawn. If the data is linear, then the slope and y -intercept (or two points) can be used to find the equation. If the data is nonlinear, skills from Algebra 2 or a graphing calculator are the best methods for determining the equation.

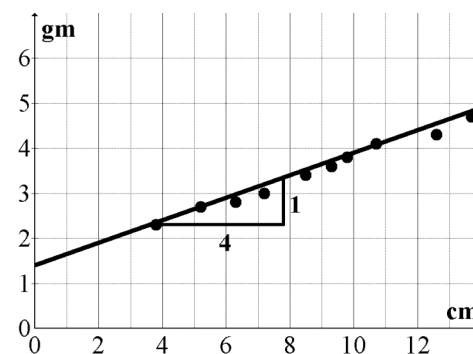
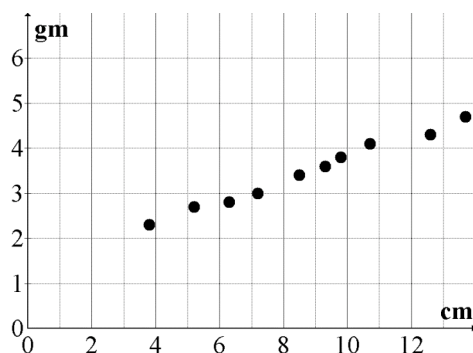
Example 1

Sam collected data by sharpening pencils and comparing the length of the painted part of the pencil to its mass. The data is listed below:

cm	3.8	5.2	6.3	7.2	8.5	9.3
gm	2.3	2.7	2.8	3.0	3.4	3.6

cm	9.8	10.7	12.6	13.7
gm	3.8	4.1	4.3	4.7

Plotting the data shows the scatterplot at top on right. The data appears linear. Use a ruler to draw the trend line as shown at bottom on right. Using two grid points and a slope triangle show that the slope is $\frac{1}{4}$. The y -intercept is about 1.4 so the approximate equation is $y = \frac{1}{4}x + 1.4$. Note that the graph is drawn small to save space. The larger you draw the graph, the more accurate it will be.



Once the line is determined, it can be used to answer further questions: If the painted part of the pencil measured 2 cm, what should its mass be?

Method 1: Use the graph and find the y -value associated with an x -value of 2 cm. The answer appear to be approximately 2 grams

Method 2: Use the equation with $x = 2$: $y = \frac{1}{4}x + 1.4 = \frac{1}{4}(2) + 1.4 = 1.9$ grams. Approximately the same answer.

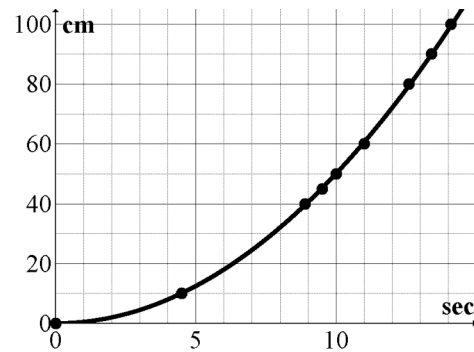
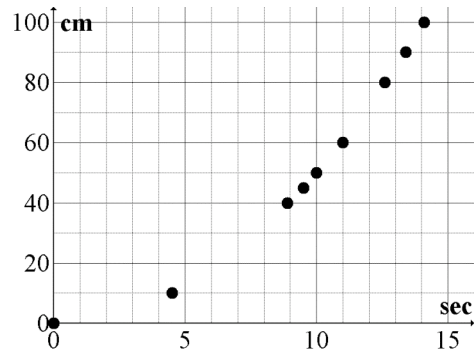
Example 2

Ms. Hoang's class did an experiment by rolling a marble down different length slanted boards and timing how long it took. The results are shown below:

sec.	10	8.9	14.1	9.5	12.6
cm.	50	40	100	45	80

sec.	0	4.5	11	13.4
cm.	0	10	60	90

Plotting the data shows the scatterplot at top on right. The data appears to be a shape of a parabola or quadratic. Sketching in a curve that approximates the data is shown at bottom on right. By guessing and checking, using Algebra 2 skills, or entering the data and using a graphing calculator, it can be shown that $y = 0.5x^2$ is a good fit.



Based on the graph (or using the equation), answer these questions: Approximately how long would it take the marble to roll 15 cm? [5.5 seconds] Approximately how far will the marble travel in 3 seconds? [4.5 cm]

Problems

1. Ms. Speedi's class measured some circular items to determine a relationship between the diameter and circumference. Their data is recorded in the table below.

diameter (cm)	circumference (cm)
3	10
5	16
10.8	32.8
13	40
10	32.3
6.8	21
4.5	18

- a. Plot the data as a scatterplot, then fit a line and write an equation for the line. b. Use your graph or equation to predict the circumference of a circular item with diameter of 8 cm.
2. The Math Club has been fundraising for months in order to buy a rocket for a homecoming demonstration. Bomani, the treasurer, expects an excellent rocket to cost roughly \$250 and wants to plan ahead. Use the information shown below from the club's bank statement for the first 10 weeks of school to estimate when they will have enough money to buy the rocket.



- a. Plot the data as scatterplot with x representing the week. Scale the axes carefully.

week number	balance
0	\$ 7.50
1	\$ 53.00
2	\$ 60.22
3	\$ 85.64
4	\$ 92.88
5	\$ 99.41
6	\$ 116.67
7	\$ 122.72
8	\$ 134.60
9	\$ 150.53

- b. Use a ruler to draw the line that best fits the data. Your line may not actually pass through any of the data points. In particular, do not connect the dots with short segments.
- c. Write the equation for your line of best fit.
- d. Use your equation from part (c) to predict when the Math Club will have enough money to buy the rocket.3. Shelley's favorite video game has decreased in cost over the past several years. The information is shown in the table below.

year	1	2	3	4	5	6
cost	\$46	\$41	\$39	\$34	\$31	\$26

- Plot the data as a scatterplot with x representing the years.
- Use a ruler to draw the trend line that best fits the data.
- Write the equation of the line.
- Use the equation to predict when the video game will cost only \$10.

For problems 4–7, plot the data and draw the curve of best fit. If the data is linear, determine the equation of the line.

- Ten circular cardboard disks were weighed and the mass and radius were recorded. The information is shown below.

cm	9.6	9.0	7.7	6.3	5.3	4.7	3.7	2.4	1.3	0
gm	5.4	4.6	3.4	2.3	1.6	1.2	0.8	0.3	0.1	0

- The average hourly wage for a technical worker over a 10-year period is shown below.

year	1	2	3	4	5	6	7	8	9	10
\$	12.00	13.25	14.00	16.00	17.00	18.00	19.50	21.00	22.00	23.25

- The population and predicted population for Smallville over a 25 year period is shown below.

year	2000	2005	2010	2015	2020	2025
people	250	237	225	211	200	189

Hint: Let $x = 0$ represent the year 2000.

- A scientist counted the size of a bacteria colony as it grew throughout the afternoon.

time	noon	1:00	2:00	3:00	4:00	5:00
bacteria	20	30	45	67	100	150

Answers

