

U.S. Shirts

1

Using Tables, Graphs, and Equations

WARM UP

Determine the value of y in each equation for the given value of x .

1. $y = -2x + 4, x = 3.5$

2. $y = \frac{1}{2}x + 11, x = -1$

3. $x + y = 1, x = 0$

4. $2x - y = 5, x = 4$

LEARNING GOALS

- Construct a table of (x, y) values and a graph to model a linear relationship between two quantities.
- Use different representations to model a problem situation.
- Analyze the characteristics of different linear representations.
- Compare linear representations using tables, graphs, and equations.

You have analyzed linear relationships by considering points on the line and rate of change. How can you compare two linear relationships in a problem situation?

① $y = -2(3.5) + 4$

$$y = -7 + 4$$

$$y = -3$$

$x = 3.5$

② $y = -5x - 6$

$$y = -5(2) - 6$$

$$y = -10 - 6$$

$$y = -16$$

Getting Started

Cost Analysis

This past summer you were hired to work at a custom T-shirt shop, U.S. Shirts. One of your responsibilities is to calculate the total cost of customers' orders. The shop charges \$8 per shirt plus a one-time charge of \$15 to set up a T-shirt design. $\rightarrow m$

1. Describe the problem situation and your responsibility in your own words.

- \$8/shirt
- \$15 fee (one-time)
- find the total cost.

2. Is the relationship between the number of shirts ordered and the total cost of an order proportional or non-proportional? Explain how you know.

$$y = mx \quad y = mx + b$$

How much is the cost for zero shirts?

$\rightarrow \$15$

non-proportional.

ACTIVITY
1.1

Modeling a Linear Relationship



Let's analyze various customer orders with U.S. Shirts.

1. What is the total cost of an order for:

a. 3 shirts?

$$\begin{array}{r} 3(8) = 24 \\ + 15 \\ \hline 39 \end{array}$$

b. 10 shirts?

$$\begin{array}{r} 10(8) = 80 \\ + 15 \\ \hline 95 \end{array}$$

c. 100 shirts?

$$\text{\$}815$$

d. Explain how you calculated each total cost.

Mult. 8, add 15

“
If the order doubles, does the total cost double?
”



2. How many shirts can a customer buy if they have:

a. \$50 to spend?

$$\frac{50 - 15}{8} = 4.4$$

4.4 → 4

b. \$60 to spend?

$$\frac{60 - 15}{8} = 5.6$$

5

c. \$220 to spend?

$$\frac{220 - 15}{8} = 27.4$$

≈ 27

d. Explain how you calculated the number of shirts that the customer can buy.

Subtract 15, divide 8

can change doesn't

3. Identify the variable quantities and constant quantities in this problem situation. Include each quantity's units.

variable → total cost
→ # of shirt
constant → \$15 fee
→ \$8 / shirt

“ Variable quantities are quantities that change, and constant quantities are quantities that don't change. ”



4. Identify the independent and dependent variables in the situation. Explain your reasoning.

of shirts (independent) X
total cost (dependent) Y

5. Complete the table of values for U.S. Shirts. Round to the nearest penny. X Y

\$8 / shirt

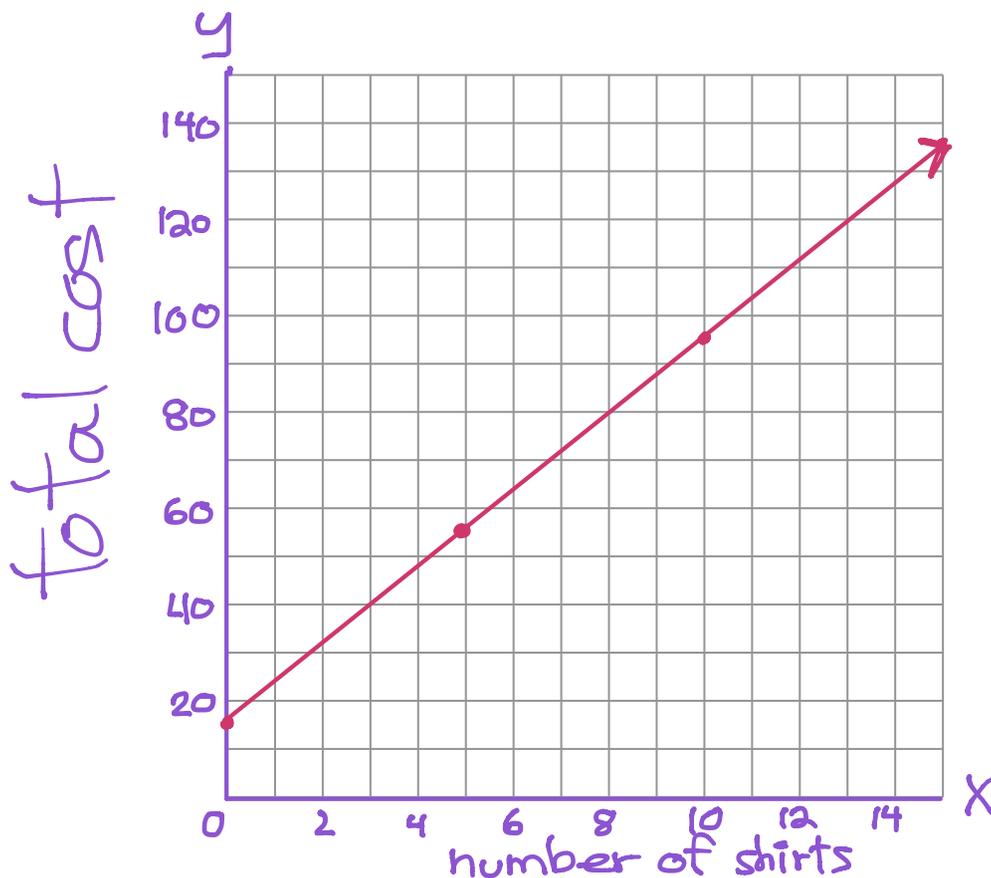
\$15 one-time fee

Number of Shirts Ordered	Total Cost (dollars)
0	15 (0, 15)
5	55 (5, 55)
10	95 (10, 95)
15	135 (15, 135)
20	175 (20, 175)
25	215 (25, 215)
50	415 (50, 415)

6. Create a graph of the data from your table on the grid shown. First, choose your bounds and intervals by completing the table shown. Remember to label your graph clearly and provide a title for your graph.

Variable Quantity	Lower Bound	Upper Bound	Interval
Number of shirts	0	15	1
Total cost	0	150	10

“ Consider all the data values when choosing your lower and upper bounds. ”



7. Define the variables and write an algebraic equation for this problem situation.

$x =$ the number of shirts
 $y =$ the total cost

$$y = 8x + 15$$

Remember, you can draw a line through your points to model the relationship. You then need to decide whether or not all points on your line make sense in terms of the problem situation.

ACTIVITY
1.2

Hot Shirts



In your own words, describe this problem situation and how it will affect the business at U.S. Shirts.

Previously, you explored a job at U.S. Shirts. One of U.S. Shirts' competitors, Hot Shirts, advertises that it makes custom T-shirts for \$5.50 each with a one-time setup fee of \$49.95. Your boss brings you the advertisement from Hot Shirts and asks you to figure out how the competition might affect business.

1. Determine the total customer cost of an order for:

a. 3 shirts.

$$\begin{array}{r} 3 \times 5.50 = 16.5 \\ + 49.95 \\ \hline \end{array}$$

b. 10 shirts.

$$104.95$$

c. 50 shirts.

$$324.95$$

$$66.45$$

d. 100 shirts.

$$599.95$$

2. Determine the number of shirts that a customer can purchase from Hot Shirts for:

a. \$50. - 49.95

$$0.05 \rightarrow 0$$

b. \$60. - 49.95

$$10.05 / 5.5 \approx 1.8$$

c. \$220. - 49.95

$$170.05 / 5.5 \rightarrow 30$$

$$1$$

3. Complete the table of values for Hot Shirts. Round to the nearest penny. $\$5.50/\text{shirt} + 49.95$

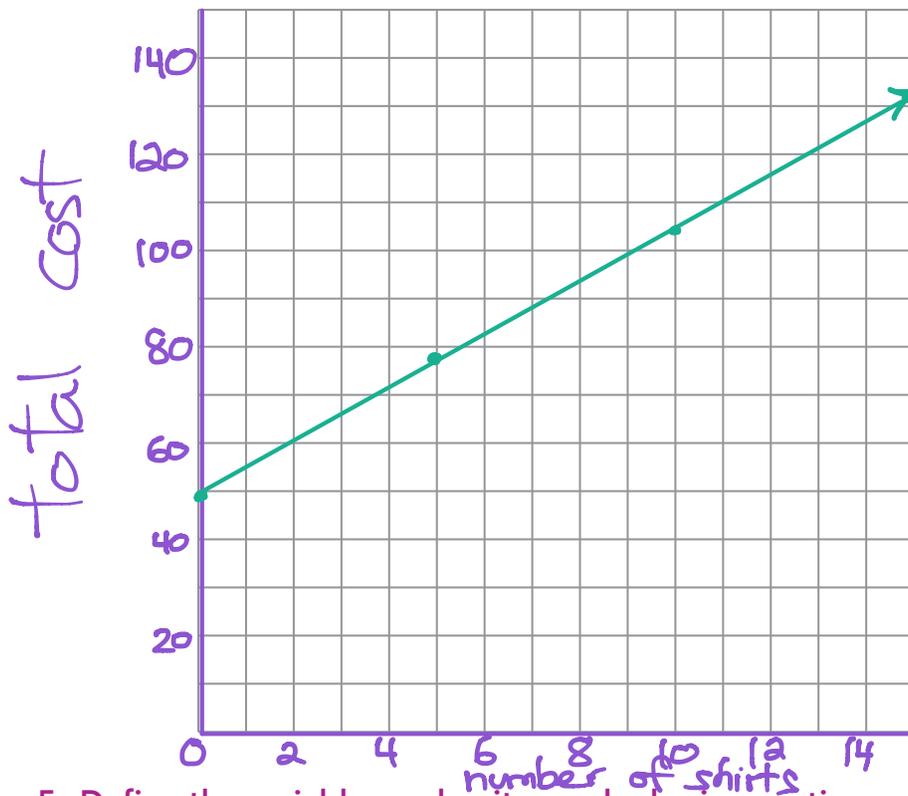
Number of Shirts Ordered	Total Cost (dollars)
0	49.95
5	77.45
10	104.95
15	132.45
20	159.95
25	187.45
50	324.95

What is your initial prediction? Is Hot Shirts a strong competitor for U.S. Shirts?



4. Create a graph of the data from the table on the grid shown. First, choose your bounds and intervals by completing the table shown. Remember to label your graph clearly and provide a title for your graph.

	Variable Quantity	Lower Bound	Upper Bound	Interval
x	Number of shirts	0	15	1
y	Total cost	0	150	10



5. Define the variables and write an algebraic equation for this problem situation.

$$x = \# \text{ of shirts}$$

$$y = \text{total cost.}$$

$$y = 5.5x + 49.95$$



You have explored the costs of ordering T-shirts from two companies, U.S. Shirts and Hot Shirts. Your boss has asked you to determine which company has the better price for T-shirts in different situations.

1. Compare the two businesses for orders of 5 or fewer shirts, 18 shirts, and 80 shirts. Is U.S. Shirts or Hot Shirts the better buy for each? What would each company charge? Describe how you calculated the values.

$$\text{U.S. Shirts : } y = 8x + 15$$

$$\text{HOT Shirts : } y = 5.5x + 49.95$$

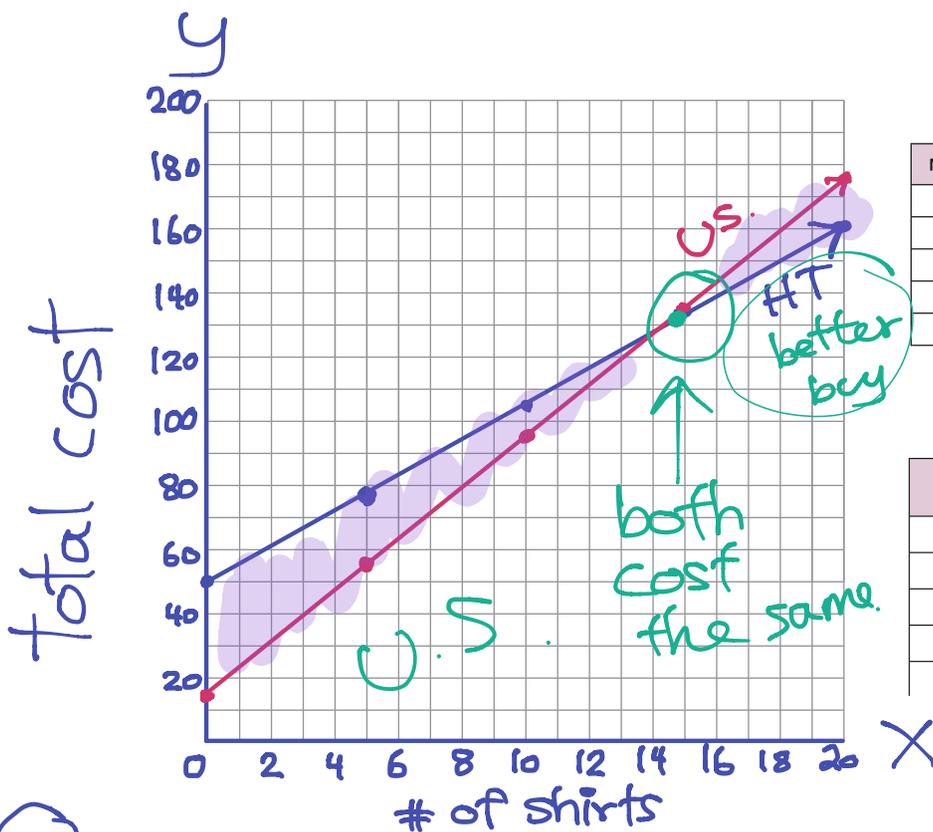
5, 18, 80

x # of shirts	y (US) total cost	y (HT) total cost
5	$8(5) + 15$ $40 + 15 = 55$	$5.5(5) + 49.95$ 77.45
18	159	148.95
80	655	489.95

2. Create graphs for the total cost for U.S. Shirts and Hot Shirts on the grid shown. Use the bounds and intervals for the grid in the table shown. Label each graph and provide a title.

Variable Quantity	Lower Bound	Upper Bound	Interval
Number of shirts	0	100 20	5 1
Total cost	0	1000 200	50 10

“ If you use a graphing calculator, adjust the bounds and intervals to those given so that your graph displays both relationships. ”

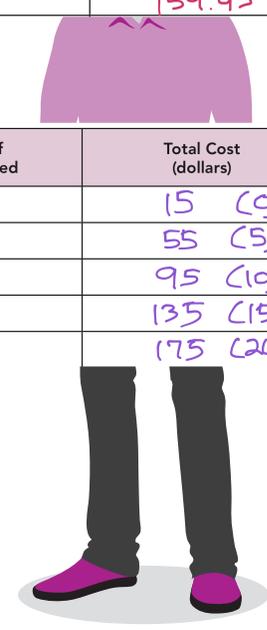


HOT

Number of Shirts Ordered	Total Cost (dollars)
0	49.95
5	77.45
10	104.95
15	132.45
20	159.95

US

Number of Shirts Ordered	Total Cost (dollars)
0	15 (0,15)
5	55 (5,55)
10	95 (10,95)
15	135 (15,135)
20	175 (20,175)



3. Estimate the number of shirts for which the total cost is the same. Explain how you determined the number of shirts.

About 14 shirts (\$127)

TALK the TALK

Business Report Presentation

Consider the graphs for U.S. Shirts and Hot Shirts. Notice that the graphs intersect at about $(14, 127)$. This point of intersection indicates where the total cost for each company is the same. Therefore, when U.S. Shirts sells 14 shirts, the total cost is \$127, and when Hot Shirts sells 14 shirts, the total cost is \$127.

1. Prepare a presentation for your boss that compares the costs of ordering from each company.

- Include a statement describing when it's better to buy from U.S. Shirts than from Hot Shirts.
- Include a statement listing the cost per shirt and startup fee for each business.
- Try to answer your boss's question: "Will Hot Shirts' prices affect the business at U.S. Shirts?"

→ It's better to buy from U.S. Shirts than from Hot Shirts if you buy less than 14 shirts.

Assignment

Write

Describe how tables, graphs, and equations are related. Then describe the advantages of each representation.

Remember

In mathematics, when representing quantities in a table it is important to include a row to identify the quantities and units of measure. Typically, the independent quantity is represented in the left column and the dependent quantity is represented in the right column.

When graphing a relationship, the convention is to represent the independent quantity on the horizontal axis of a graph and the dependent quantity on the vertical axis. You should include labels on each axis.

When writing an equation in the form of $y = mx + b$, the x -value represents the independent quantity and the y -value represents the dependent value. It is important to define the variables you choose.

Practice

- Great Freights, a local shipping company, bases its charges on the weight of the items being shipped. In addition to charging \$0.40 per pound, Great Freights also charges a one-time fee of \$10 to set up a customer's account.
 - How much does Great Freights charge a new customer to ship a package that weighs 20 pounds?
 - How much does Great Freights charge a new customer to ship a package that weighs 50 pounds?
 - Estimate the weight of a package if Great Freights charges a new customer \$45 to ship the package.
 - Write an equation for the problem situation.
- Twin brothers, Mike and Mark, are looking for week-long winter break jobs. They are both offered jobs at grocery stores. Mike is offered a job at Fresh Foods making \$10 per hour. Mark is offered a job at Groovy Groceries making \$8 an hour, plus a one-time hiring bonus of \$100. Each twin believes that he has been offered the better job.
 - How much does Mike earn at Fresh Foods if he works 20 hours? 40 hours? 60 hours? Show your work.
 - Explain how you determined Mike's earnings in part (a).
 - How much does Mark earn at Groovy Groceries if he works 20 hours? 40 hours? 60 hours? Show your work.
 - Explain how you determined Mark's earnings in part (c).
 - Create a table using the data and your answers from parts (a) and (c).
 - Create a graph of the data in the table in part (e). First, choose your bounds and intervals. Remember to label your graph clearly and name your graph.
 - After how many hours will the twins earn the same amount of money? Explain your reasoning.
 - Whose job is better, Mike's or Mark's? Explain your reasoning.

Stretch

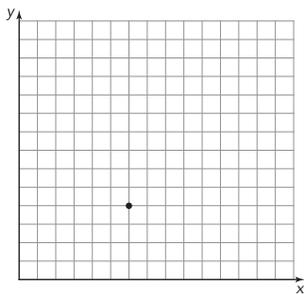
Two catering companies have different one-time fixed fees. Company A charges a fixed fee of \$75, and Company B charges a fixed fee of \$100. Each company also has a cost per person.

Suppose the independent quantity is the number of people and the dependent quantity is the cost. The graphs for the two companies never intersect. What does this tell you about how much each company charges?

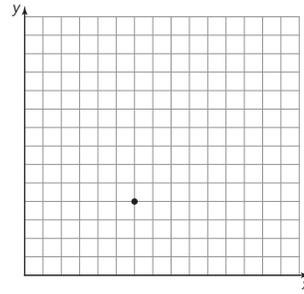
Review

1. Draw a line through the point and label the graph to represent each linear relationship. Then, write an equation to represent the relationship.

a. linear proportional relationship



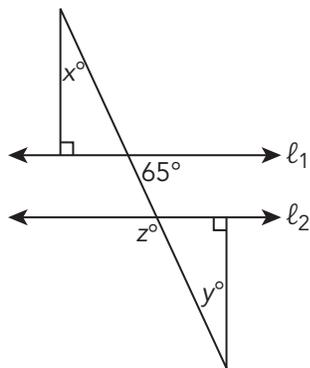
b. linear non-proportional relationship



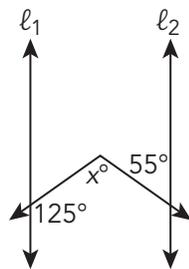
2. Use the equation $y = -3x$ to complete the table of values. Graph the equation. Then use the points on the graph to sketch similar triangles that may be used to show the rate of change of the line is the same between any two points.

3. Solve for each unknown angle measure given that $l_1 \parallel l_2$.

a.



b.



x	y
-2	
-1	
0	
1	
2	