LESSON 1

U.S. Shirts

Using Tables, Graphs, and Equations

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.

REVIEW (1–2 minutes)

Solve each equation for x.

1. $-3 = -2x + 4$
2. $10\frac{1}{2} = \frac{1}{2}x + 11$
3. $5x + 1 = 1$
4. $2x - 3 = 5$

© Carnegie Learning, Inc.

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?

Cost Analysis

You work at a custom T-shirt shop, U.S. Shirts, over the summer. 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.

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

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.**

© Carnegie Learning, Inc.

Modeling a Linear Relationship

HABITS OF MIND
- Model with mathematics.
- Use appropriate tools strategically.

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

1 What is the total customer cost for each order of shirts?

(a) 3 shirts (b) 10 shirts (c) 100 shirts

(d) Explain how you calculated each total cost.

ASK YOURSELF . . .
Does the total cost double when the order doubles?

2 How many shirts can a customer buy for each amount?

(a) $50 (b) $60 (c) $220

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

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

DID YOU KNOW?
Variable quantities are quantities that change, and constant quantities are quantities that don't change.

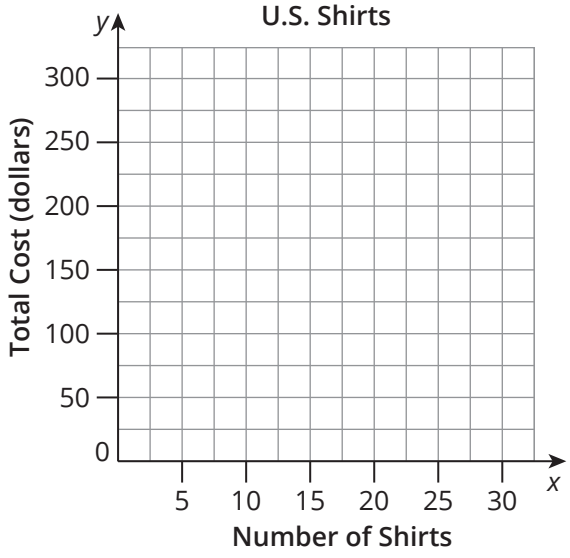
4 Identify the independent and dependent variables in the situation. **Explain your reasoning.**

© Carnegie Learning, Inc.

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

Number of Shirts Ordered	Total Cost (dollars)

6 Create a graph of the data from your table.



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.

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

© Carnegie Learning, Inc.

Modeling Another Linear Relationship

Previously, you modeled the total cost of a customer's order at U.S. Shirts.

HABITS OF MIND
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.

One of U.S. Shirts's 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.

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

1 What is the total customer cost for each order of shirts from Hot Shirts?

(a) 3 shirts

(b) 10 shirts

(c) 50 shirts

(d) 100 shirts

2 How many shirts can a customer buy from Hot Shirts for each amount?

(a) $50

(b) $60

(c) $220

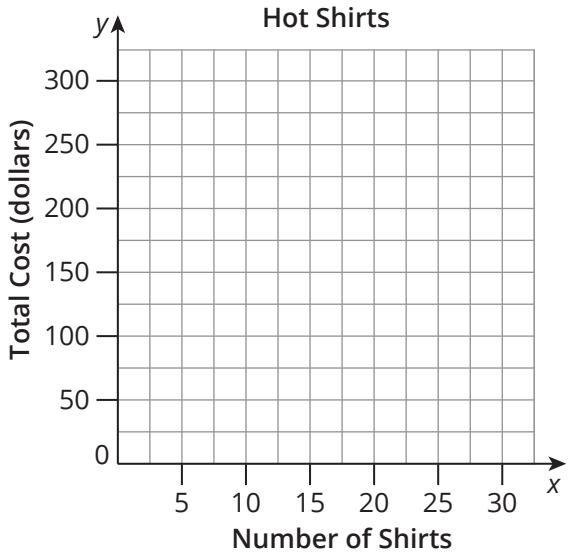
© Carnegie Learning, Inc.

3 Complete the table of values for Hot Shirts. Round to the nearest penny.

Number of Shirts Ordered	Total Cost (dollars)

ASK YOURSELF . . .
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.



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

© Carnegie Learning, Inc.

Comparing Linear Relationships

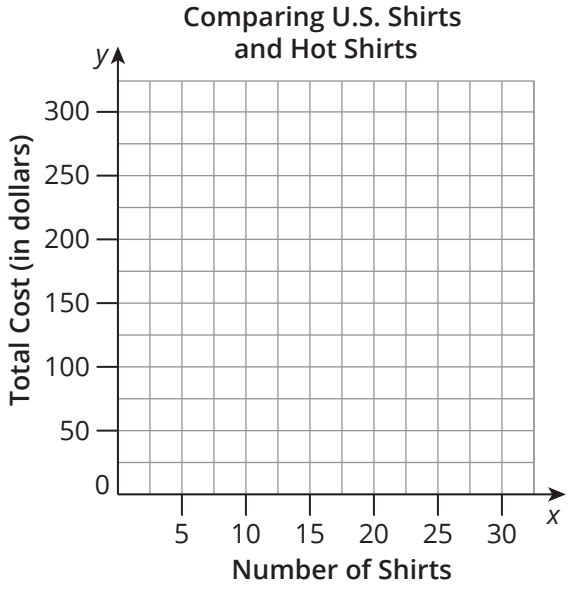
You have explored the costs of ordering T-shirts from two companies, U.S. Shirts and Hot Shirts.

HABITS OF MIND
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning.

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.**

2 Create graphs for the total cost for U.S. Shirts and Hot Shirts.



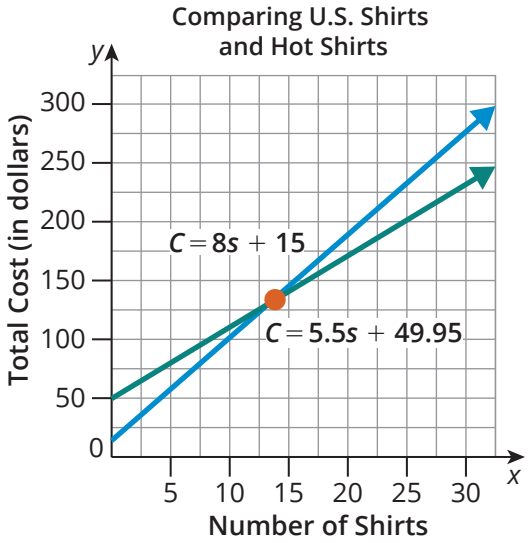
TAKE NOTE . . .
When using graphing technology, adjust the bounds and intervals to those given so that your graph displays both relationships.

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

© Carnegie Learning, Inc.

Business Report Presentation

Consider the graphs for U.S. Shirts and Hot Shirts.



Notice that the graphs appear to intersect at the point (14, 127). This point of intersection indicates where the total cost for each company is the same. When U.S. Shirts sells 14 shirts, the total cost is $127, and when Hot Shirts sells 14 shirts, the total cost is about $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 setup fee for each business.
   - Try to answer your boss's question: "Will Hot Shirts's prices affect the business at U.S. Shirts?"

© Carnegie Learning, Inc.

LESSON 1 ASSIGNMENT

› Use a separate piece of paper for your Journal entry.

JOURNAL

Describe the relationship between tables, graphs, and equations. Then, describe the advantages of each representation.

REMEMBER

You can model linear relationships using a table of values, a graph, and an equation. It is important to define the variables you choose to represent the independent and dependent quantities, and to identify the units of measure. You can use these representations to compare different linear relationships.

PRACTICE

1 Great Freights, a local shipping company, bases its charges on the weight of the shipped items. 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.

(a) How much does Great Freights charge a new customer to ship a package that weighs 20 pounds?

(b) How much does Great Freights charge a new customer to ship a package that weighs 50 pounds?

(c) Estimate the weight of a package when Great Freights charges a new customer $45 to ship the package.

(d) Write an equation for this problem situation.

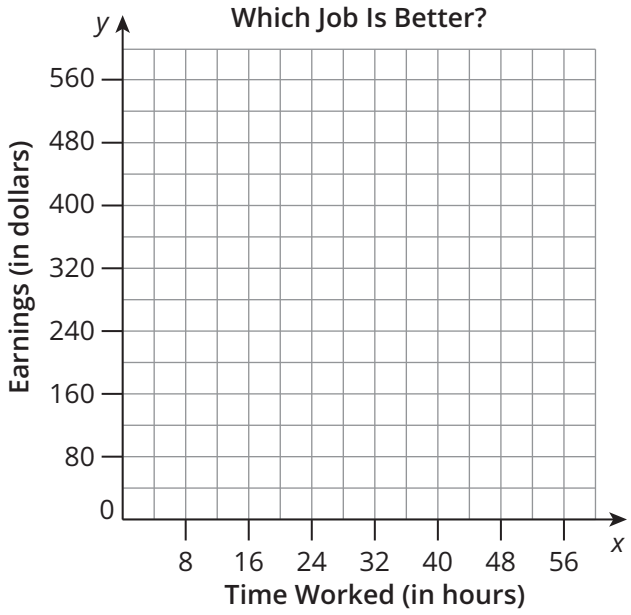
© Carnegie Learning, Inc.

2 Twin brothers, Mike and Mark, both get job offers at grocery stores. Mike gets a job offer at Fresh Foods making $10 per hour. Mark gets a job offer at Groovy Groceries making $8 an hour, plus a one-time hiring bonus of $100. Each twin believes his job offer is better.

(a) Complete the table of values for the given number of hours worked.

Time Worked (in hours)	Mike's Earnings at Fresh Foods (in dollars)	Mark's Earnings at Groovy Groceries (in dollars)
0		
20		
40		
60		

(b) Create a graph of the data.



(c) Whose job offer is better, Mike's or Mark's? Explain your reasoning.

STRETCH Optional

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.

1 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?

© Carnegie Learning, Inc.