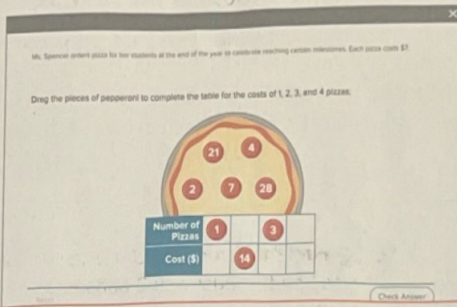


Tables of Proportional Relationships

I Can... determine whether two quantities shown in a table are in a proportional relationship by testing for equivalent ratios.

Explore Ratios in Tables

Online Activity You will explore how to determine if the ratios between two quantities are equivalent.



What Vocabulary Will You Learn?
constant of proportionality
nonproportional
proportional

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Learn Proportional Relationships and Tables

Two quantities are **proportional** if the ratios comparing them are equivalent.

In the table, all of the ratios comparing the cost to the number of pizzas are equivalent and have a unit rate of $\frac{\$7}{1 \text{ pizza}}$. So, the cost of the order is proportional to the number of pizzas ordered.

Number of Pizzas	1	2	3	4
Cost (\$)	7	14	21	28
Cost per Pizza (\$)	7	7	7	7

In relationships where these ratios are not equivalent, the two quantities are **nonproportional**.

In the table below, the ratios comparing the cost to the number of pizzas are different. So, the relationship represented by this table is nonproportional.

Number of Pizzas	1	2	3	4
Cost (\$)	9	16	23	30
Cost per Pizza (\$)	9	8	7.67	7.50

Talk About It!

How can you use ratios to determine if a relationship is proportional?

Think About It!
What makes a relationship proportional?

Example 1 Proportional Relationships and Tables

Carrie earns \$8.50 per hour babysitting.

Is the amount of money she earns proportional to the number of hours she spends babysitting?

Complete the table with the amount of money she earns for babysitting 1, 2, 3, and 4 hours.

Number of Hours	1	2	3	4
Amount Earned (\$)	8.5	17	25.5	34

You can check proportionality by writing each ratio with the same denominator. The most efficient denominator is 1, which is also the unit ratio. The relationship between the amount earned, in dollars, and the hours spent babysitting for each number of hours is shown.

$$\frac{8.5}{1} = \frac{8.5}{1} \quad \text{yes it's proportional} \quad \frac{17}{2} = \frac{8.5}{1}$$

$$\frac{25.5}{3} = \frac{8.5}{1} \quad \frac{34}{4} = \frac{8.5}{1}$$

So, the relationship is proportional because the ratios between the quantities are equivalent and have a unit rate of \$8.50 per hour.

Check

An adult elephant drinks about 225 liters of water each day. Is the amount of water proportional to the number of days that have passed? Use the table provided to help answer the question.

Time (days)	1	2	3	4
Water (L)	225	450	675	900

Show your work here

450, 1350, 450, 1380
yes, it's proportional

Example and Tables

A ticket agency charges a \$6 service fee and a concert costs \$25.
is the cost of an order proportional to the number of tickets ordered?

The table shows the relationship between the total cost of an order and the number of tickets ordered.

Number of Tickets	Total Cost of Order (\$)
-------------------	--------------------------

1	2	3	4
31	56	81	106

The cost of each additional ticket is an additional \$25 because the service fee is only charged once per order.
For each number of tickets, write the relationship of the total cost to the number of tickets as a ratio with a denominator of 1. The first two are done for you.

$$\frac{31}{1} = \frac{31}{1}$$

$$\frac{56}{2} = \frac{28}{1}$$

$$\frac{106}{4} = \frac{26.5}{1}$$

$$\frac{81}{3} = \frac{27}{1}$$

Because the ratios between the quantities are not the same, the cost of an order is not proportional to the number of tickets ordered.

Check

The table shows how long it took Maria to run laps around the school track. Is the number of laps she ran proportional to the time it took her? Explain.

Laps	2	4	6
Time (s)	150	320	580

600 640

Not proportional

Not Proportional

Talk About It!

What part of the scenario made the situation nonproportional? Explain your reasoning.

Example 2 Identify the Constant of Proportionality

The two tables show that two quantities are proportional if the ratios comparing them are equivalent or constant. The constant ratio is called the **constant of proportionality**. The constant of proportionality has the same value as the unit rate.

Creators of a stop motion animation can film 24 frames per second. The table shows the number of frames captured over 1, 2, 3, and 4 seconds.

Number of Seconds	1	2	3	4
Number of Frames	24	48	72	96

What is the constant of proportionality? 24

What is the unit rate? 24

Because the constant ratio is $\frac{24}{1}$, the constant of proportionality is 24, and the unit rate is 24 frames per second.

Example 3 Identify the Constant of Proportionality

The winner of a jump rope competition jumped 124 times in 20 seconds and 186 times in 30 seconds.

What is the constant of proportionality?

Write the equivalent ratios so that each ratio has a denominator of 1.

$$\frac{124 \text{ jumps}}{20} = \frac{6.2}{1 \text{ second}}$$

$$\frac{186}{30 \text{ seconds}} = \frac{6.2}{1 \text{ second}}$$

Because the constant ratio is $\frac{6.2}{1}$, the constant of proportionality is 6.2, and the unit rate is 6.2 jumps per second.

If the constant is the same they are proportional

Check

The cost of a birthday party at a skating rink is proportional to the number of guests. The skating rink charges \$82.50 for 10 guests.

The choices show the number of guests and the total cost for four different parties that were hosted at different locations. Select each party that was hosted with the same constant of proportionality, or unit rate, as the skating rink's unit rate.

- $99 \div 12 = 8.25$ ☒ 12 guests for \$99.00
 $52 \div 8 = 6.5$ ☒ 8 guests for \$52.00
 $17 \div 5 = 3.4$ ☒ 15 guests for \$97.50
 $49.5 \div 6 = 8.25$ ☒ 6 guests for \$49.50

Show your work here

82.5 10
 99 12
 990 990

Notes
have the same constant of proportionality mean Proportional

Go Online You can complete an Extra Example online.

Example 4 Identify the Constant of Proportionality

After a volcanic eruption, lava flows down the slopes of the volcano. The distance the lava flows is proportional to the time.

Time (min)	Distance (m)
5	9
10	18
15	27
20	36

What is the constant of proportionality of the flow of lava?

For each time, find the ratio $\frac{\text{number of meters}}{\text{number of seconds}}$ and rewrite it with a denominator of 1.

$$\frac{9}{5} = \frac{1.8}{1}$$

$$\frac{18}{10} = \frac{1.8}{1}$$

$$\frac{27}{15} = \frac{1.8}{1}$$

$$\frac{36}{20} = \frac{1.8}{1}$$

Because the constant ratios are $\frac{1.8}{1}$, the constant of proportionality is 1.8, and the unit rate is 1.8 meters per second.

Think About It!

Why is a table a good way to organize the information?

Talk About It!

What does the constant of proportionality, 1.8, mean in the context of the problem?



Math History Minute

Erika Tatiana Camacho (1974-) is a Mexican-American mathematical biologist and Associate Professor at Arizona State University. In 2014, she won the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring. Her high school teacher and mentor was Jaime Palante, the subject of the 1988 movie *Stand and Deliver*.

Check

The tables show the amount that three friends earn during a bake sale. Write the correct unit rate that each friend earned in the spaces provided.

Allie			
Earnings (\$)	17.00	34.00	51.00
Time (h)	1	2	3

17

Ben			
Earnings (\$)	9.00	18.00	27.00
Time (h)	0.75	1.5	2.25

$$9 \div 0.75 = 12$$

Sri			
Earnings (\$)	40.00	80.00	120.00
Time (h)	2.5	5	7.5

$$40 \div 2.5 = 16$$

Allie

constant
of proportionality

17

Ben

constant
of proportionality

12

Sri

constant
of proportionality

16

Show your work here

Apply Sales Tax

Jalen went shopping for school clothes. The table shows the sales tax for various purchase amounts. Is the sales tax proportional to the purchase amount? What is the total cost, in dollars, for a purchase amount of \$84?

Purchase Amount (\$)	12	24	36	48
Sales Tax (\$)	0.60	1.20	1.80	2.40

1 What is the task?

Make sure you understand exactly what question to answer or problem to solve. You may want to read the problem three times. Discuss these questions with a partner.

First Time Describe the context of the problem, in your own words.

Second Time What mathematics do you see in the problem?

Third Time What are you wondering about?

2 How can you approach the task? What strategies can you use?

Record your observations here.

$$a = \frac{12}{0.60} = 20$$

$$c = \frac{36}{1.80} = 20$$

$$b = \frac{24}{1.20} = 20$$

$$d = \frac{48}{2.40} = 20$$

3 What is your solution? So, $a = b = c = d$

Use your strategy to solve the problem.

Show your work here.

$$\frac{84}{x} = 20 \quad x = 4.2$$

Total cost

$$84 + 4.2 = \$88.2$$

4 How can you show your solution is reasonable?

Write About It! Write an argument that can be used to defend your solution.

Talk About It!

If the relationship was not proportional, could you solve this problem? Explain.

Check

The table shows three membership options at a fitness center.

Membership	Cost
Basic	\$20 per class
Fit Plus	\$60 per month plus \$10 per class
Fit Extreme	\$75 per month plus \$30 enrollment fee

Logan chooses the membership that represents a proportional relationship between the number of classes and the monthly cost. Which membership did Logan choose? How much will he spend if he takes 12 classes in a month?

The only proportional Relationship
is Basic membership
is 20 so 12 classes =

$$12 \times 20 = \$240 \text{ classes}$$

in 12 classes

 **Go Online** You can complete an Extra Example online.

 **Foldables** It's time to update your Foldable, located in the Module Review, based on what you learned in this lesson. If you haven't already assembled your Foldable, you can find the instructions on page FL1.

proportional	Write about it
nonproportional	Write about it

Practice

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Mrs. Ayman

Go Online You can complete your homework online.

For each situation, complete the table given. Does the situation represent a proportional relationship? Explain.

1. The cost of a school lunch is \$2.50. (Example 1)

Lunches Bought	1	2	3	4
Total Cost (\$)	2.50	5	7.5	10

proportional

2. Anna walks her dog at a constant rate of 12 blocks in 8 minutes. (Example 1)

Number of Blocks	12	24	36	48
Number of Minutes	8	16	24	32

proportional

3. Fun Center rents popcorn machines for \$20 per hour. In addition to the hourly charge, there is a rental fee of \$35. (Example 2)

Hours	1	2	3	4
Cost (\$)	55	75	95	115

Not proportional

4. Jean has \$280 in her savings account. Starting next week, she will deposit \$30 in her account every week. (Example 2)

Weeks	1	2	3	4
Savings (\$)	310	340	370	400

$$280 + 30 = 310$$

$$310 + 30 = 340$$

$$340 + 30 = 370$$

Not proportional

5. Rocko paid \$12.50 for 25 game tickets. Louisa paid \$17.50 for 35 game tickets. What is the constant of proportionality? (Example 3)

$$\frac{12.5}{25} = \frac{17.5}{35} = \frac{25}{50} = \frac{5}{10} = \frac{1}{2}$$

$$= 0.5$$

6. A baker, in 70 minutes, iced 40 cupcakes and, in 49 minutes, iced 28 cupcakes. What is the constant of proportionality? (Example 3)

$$\frac{40}{70} = \frac{4}{7}$$

Test Practice

7. The table shows the amount of dietary fiber in bananas. Use the table to find the constant of proportionality. (Example 4)

Dietary Fiber (g)	9.3	18.6	27.9	37.2
Bananas	3	6	9	12

$$\frac{9.3}{3} = 3.1$$

8. Open Response The table shows the distance traveled by a runner. Use the table to find the constant of proportionality.

Distance (mi)	4.55	13.65	22.75	31.85
Time (h)	0.5	1.5	2.5	3.5

$$\frac{4.55}{0.5} = 9.1$$

Apply

9. The table shows the amount a restaurant is donating to a local school based on various dinner bills. Is the amount of the donation proportional to the dinner bill? If so, what would be the donation for a dinner bill of \$50? If not, explain.

$$k = \frac{y}{x} \quad \frac{25 \times 2}{4.50 \times 2} = \frac{50}{9}$$

$$\frac{30}{5.40} = \frac{50}{9} \quad \frac{35}{6.30} = \frac{50}{9} \quad \frac{40}{7.20} = \frac{50}{9}$$

$$k = \frac{y}{x} \quad x = 9$$

Donations	
Dinner Bill (\$)	Donation (\$)
25	4.50
30	5.40
35	6.30
40	7.20

DIN 25 50
4.50 9

10. The table shows the cost to mail various letters based on different weights. Is the cost of mailing a letter proportional to the weight? If so, what would be the cost of mailing a 6-ounce letter? If not, explain.

cost ounce

$$\begin{array}{r} 0.47 \\ ? \end{array} \times \frac{1}{6}$$

$$6 \times 0.47 = 2.82$$

Mailing Costs	
Weight (oz)	Cost (\$)
1	0.47
2	0.68
3	0.89
4	1.10

11. There are 8 fluid ounces in one cup. If you double the amount of fluid ounces, will the amount of cups also double? Write an argument that can be used to defend your

12. Determine whether the cost of renting equipment is *sometimes*, *always*, or *proportional*. Explain.