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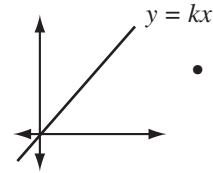
Linear Relations (2)



Words TO LEARN

Direct variation:

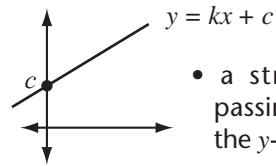
a relation where two variable quantities have a constant ratio called the constant of variation. The formula for direct variation is $y = kx$, where $k =$ constant of variation.



- a straight line passing through the origin

Partial variation:

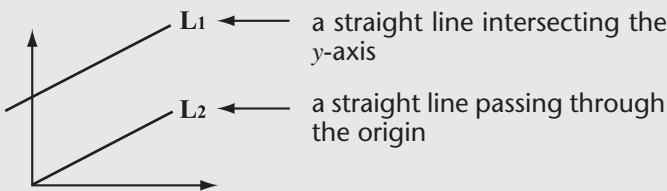
a relation where one variable is a constant of the other, plus another constant. The formula for partial variation is $y = kx + c$, where $k =$ constant of variation and $c \neq 0$.



- a straight line passing through the y-axis at c

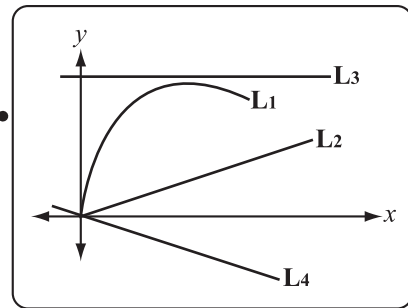
Example

Look at the lines on the graph. State whether it shows a direct variation, a partial variation, or neither.



L1: a partial variation L2: a direct variation

Try This



L1: _____

L2: _____

L3: _____

L4: _____

State whether each equation represents a direct or partial variation. Then find the constant of variation and constant term.

① $y = \frac{1}{3}x + 6$

② $4y = -16x$

③ $2x - y = 9$

④ $\frac{1}{2}x + 10 - y = 6$

	Variation	Constant of Variation	Constant Term
①	_____	_____	_____
②	_____	_____	_____
③	_____	_____	_____
④	_____	_____	_____

Write an algebraic equation to match each situation. Then state each situation as a direct or partial variation.

- ⑤ The cost of staying in a hotel is \$89/night.

$y = 89x$ where y = the total cost
' and x = no. of nights

It is a _____ variation.

- ⑥ The cost of renting a car is \$50/day plus \$25 service charge.

- ⑦ The speed of sound in air is 331.4 m/s plus 0.6 m/s for each degree Celsius above zero.

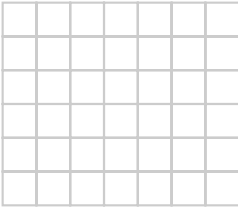
- ⑧ There are 16 floor tiles in each row.

Make a table of values for each of the situations above. Then graph it and state whether it is a linear or nonlinear relation.

⑨

x	y
0	
2	
4	

Total Cost

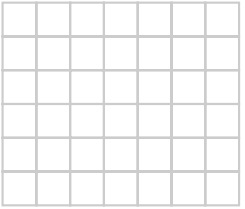


It is a _____ relation.

⑩

x	y
1	
2	
3	

Cost of Renting

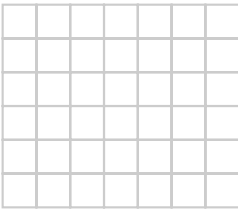


It is a _____ relation.

⑪

x	y
0	
10	
20	

Speed of Sound

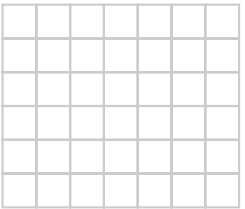


It is a _____ relation.

⑫

x	y
0	
4	
8	

Total No. of Tiles



It is a _____ relation.

Complete the difference table for each table of values. Then state whether the data represents a linear or nonlinear relationship.

⑬

x	y	Δy
1	6	
2	11	$11 - 6 =$
3	16	$16 - 11 =$
4	21	

a _____ relationship

⑭

x	y	Δy
2	11	
4	15	$15 - 11 =$
6	26	
8	43	

a _____ relationship

⑮

x	4	2	3	1
y	8	24	11	5

x	y	Δy

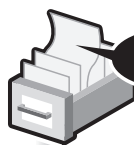
a _____ relationship

⑯

x	4	3	6	5
y	24	18	36	30

x	y	Δy

a _____ relationship



HINT

A table of values represents a linear relationship if the finite differences are the same for each row in the difference table*.

e.g.

x	y	Δy
1	10	
2	14	$14 - 10 = 4$
3	18	$18 - 14 = 4$

constant change

The finite difference is always 4.

So, this relationship is linear.

* Make sure that the values for the independent variables are put in order from smallest to largest.

Identify the data above that has a linear relationship. Graph it. Then state whether it shows a direct or partial variation.



Complete the difference table to show that the relationship is linear. Then find and use the equation of the relationship to solve the problems.



Find the equation of the line if there is a linear relationship.

Δx	x	y	Δy	$\frac{\Delta y}{\Delta x}$
	0	3		
2	2	-1	-4	-2
2	4	-5	-4	-2

$\frac{\Delta y}{\Delta x}$ is always -2. So, there is a linear relationship.

So, the equation of this relationship: $y = -2x + 3$

A table of values represents a linear relationship if for all pairs of points in the table, the ratio of the differences between the x -values and the corresponding differences between the y -values are the same.

Linear relation: $y = kx + c$, $k = \frac{\Delta y}{\Delta x}$
 $c =$ initial value

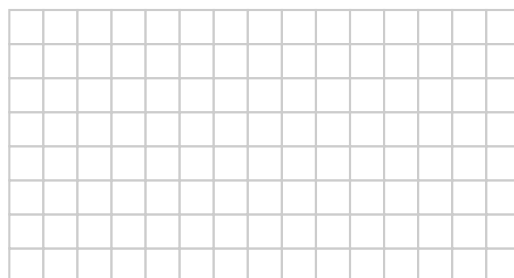
- 18 Complete the table that shows the rates for a club membership and graph the data.

a.

Δx	x	y	Δy	$\frac{\Delta y}{\Delta x}$
	0	90		
	3	135		
	6	180		
	9	225		

x : no. of months y : membership fees

Rates of Membership



- b. The equation of this relationship:

- c. The membership fees for 1 year:

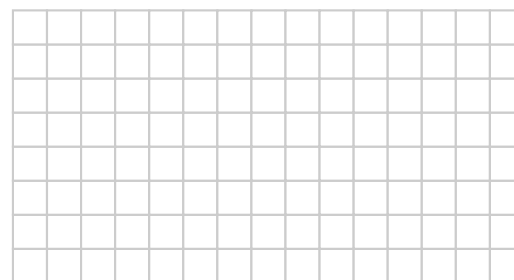
- 19 Complete the table that shows the cost of renting a party room and graph it.

a.

Δx	x	y	Δy	$\frac{\Delta y}{\Delta x}$
	5	60		
	10	120		
	15	180		
	20	240		

x : no. of guests y : total cost

Cost of Renting a Party Room



- b. The equation of this relationship:

- c. The total cost for 30 guests:

Plot a scatter plot for each group of data. Tell whether it indicates a positive or negative correlation. Draw the line of best fit. Then check the most appropriate equation to match the line.

20

A	<i>x</i>	1	3	4	2	3	4	1	2	3	4
	<i>y</i>	45	70	80	65	90	85	65	70	85	90
B	<i>x</i>	1	3	4	2	1	4	3	2	1	1
	<i>y</i>	80	65	60	85	90	70	75	80	95	85
C	<i>x</i>	8	1	2	5	3	2	4	6	5	7
	<i>y</i>	15	40	41	30	35	36	30	25	28	20

A



a _____ correlation

- $y = 45 - 10x$
- $y = 10x + 45$
- $y = 45x - 10$

B



- $y = 95 - 8x$
- $y = -8x - 95$
- $y = 8x + 95$

C



- $y = 40 + 3x$
- $y = 40x - 3$
- $y = 40 - 3x$

Find the missing number of the equation of the line of best fit that matches each group of data.

21

<i>x</i>	<i>y</i>
1	3
2	4
3	4.8
5	8
6	7.5

$y = x + \square$

22

<i>x</i>	<i>y</i>
1	3.1
2	6.4
3	9
4	13
5	14.6

$y = \square x$

23

<i>x</i>	<i>y</i>
1	-4.1
2	-2
4	0
5	1.2
7	2.8

$y = x - \square$

Plot the points on a scatter plot. Tell whether the plot indicates a positive or negative correlation. Then draw the line of best fit and answer the questions.

24

Red Wine	
Age (years)	Price (\$)
1	12
2	24
3	34
2	23
5	60
4	50
3	33
4	47
5	62
1	13
3	35

a.

Price of a Bottle of Red Wine and its Age



- b. This indicates a _____ correlation.
- c. Suggest an equation in the form $y = kx$ for the line of best fit. _____
- d. If the price of a bottle of wine is about \$83, predict the age of the wine. _____

25

Speed (km/h)	Time (h)
60	5.6
65	5.2
70	4.9
40	8.5
50	7
60	5.7
90	3.6
80	4.3
85	4
90	3.9
45	7.6

a.

Time Taken to Drive from Town A to Town B at Different Speeds



- b. This indicates a _____ correlation.
- c. Suggest an equation in the form $y = kx + 12$ for the line of best fit. _____
- d. If the speed of the car is 75 km/h, predict how long it takes to drive from Town A to Town B. _____



If you have grasped the concepts and learned the necessary skills, you may go to Section 3 (p.162) to apply them in solving word problems.