

In the town of Linelanes, the bowling rates are based on a linear equation. The cost for 3 games is \$10.50, while 5 games ride cost \$17.00. This includes the cost of shoe rental (you only pay for that once, no matter how many games you play).

1. Find a linear equation that fits the given information.
2. How much does the shoe rental cost?
3. How many games can you play if you have \$30 to spend at the bowling alley?

**Extra:** How many games could my brother and I play if we had \$50 to spend (and we each wanted to play the same number of games)? How would the linear equation be different for 2 players?

## MATH STANDARDS ALIGNMENT

CCSS.MATH.CONTENT.8.F.B.4

Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

**Personal Finance Big Ideas:**  
*What is Money*

## METHOD 1

1. I want to find the linear equation that expresses how much bowling costs. I have two pieces of information that I can think of as data points. I know the cost of 3 games is \$10.50 and the cost of 5 games is \$17.00. I also know that I have to rent shoes and pay for that as well.

I can think of these two points as:

$$(3, \$10.50) \rightarrow (x_1, y_1)$$

$$(7, \$17.00) \rightarrow (x_2, y_2)$$

I also know the formula for a linear equation is  $y = mx + b$

I can first find  $m$ , the slope, by using the two points above and I know the following variables represent:

let  $x$  = the number of games played

let  $y$  = the total cost including shoes

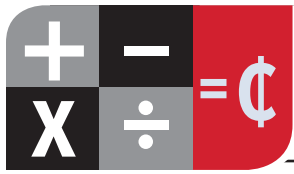
$m$  = the slope of the equation

$$m = (y_2 - y_1) / (x_2 - x_1)$$

$$m = (17.00 - 10.50) / (5 - 3)$$

$$m = 6.50 / 3$$

$$m = 3.25$$



So now I know, so far, that the equation is:  $y = 3.25x + b$

$b$  = the y-intercept of the equation or in this case, the cost of shoes

$$y = 3.25x + b$$

I can substitute point (3, 10.50) for  $x$  and  $y$  values:

$$10.50 = 3.25(3) + b$$

$$10.50 = 9.75 + b$$

$$0.75 = b$$

So now, I can see that the equation is:  $y = 3.25x + 0.75$

2. I can use the equation I just found to figure out the cost of the shoe rental. The equation is:

$$y = 3.25x + 0.75$$

This means that I multiply the number of games I play by \$3.25 and I add the cost of the shoe rental, \$0.75.

3. If I have \$30, I can see how many games I can play by using my linear equation and substituting 30 as the value of  $y$

$$30 = 3.25x + 0.75$$

$$29.25 = 3.25x$$

$$9 = x$$

I can play 9 games exactly if I have \$30, this includes the price of my shoes!

### METHOD 2

1. I want to find a linear equation that represents the cost of bowling. I have two pieces of information:

- 3 games is \$10.50
- 5 games is \$17.00

My equation will be:

$$\text{Total Cost} = \text{Price Per Game} * \text{Number of Games} + \text{Shoe Rental Cost}$$

I will assign the following variables:

Let  $y$  = Total Cost

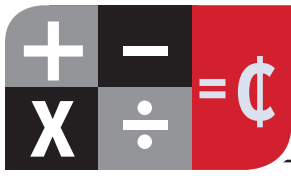
Let  $x$  = Number of Games

So for my equation,  $y = mx + b$ ,

$m$  = slope = Price Per Game

$b$  = y-intercept = Shoe Rental Cost





Now, using the two pieces of information I have, I can see that:

$$10.50 = 3m + b$$

and

$$17.00 = 5m + b$$

Now I can use these two equations to solve for  $m$  by using linear combination as follows:

$$10.50 = 3m + b$$

$$17.00 = 5m + b$$

To combine these, I'll multiply  $10.50 = 3m + b$  by  $(-1)$  and add it to  $17.00 = 5m + b$

$$17.00 = 5m + b$$

$$-10.50 = -3m - b$$

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$$6.50 = 2m$$

$$3.25 = m$$

Now, I can see that  $m$ , my slope and the cost per game, is \$3.25. I can use this slope value to solve for  $b$ .

$$17.00 = 5m + b$$

$$17.00 = 5(3.25) + b$$

$$17.00 = 16.25 + b$$

$$0.75 = b$$

Now that I know the cost per game and the shoe rental, or  $m$  and  $b$ , I can write my equations:

$$y = 3.25x + 0.75$$

2. Well, now that I have my equation, and I understand what it means, I can see that the cost of the shoe rental is \$0.75.

3. To figure out how many games I can play with \$30, I can use my linear equation:

$$30 = 3.25x + 0.75$$

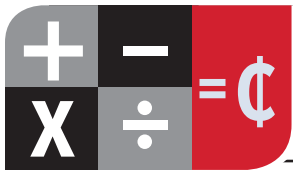
$$29.25 = 3.25x$$

$$9 = x$$

I can play 9 games exactly if I have \$30, this includes the price of my shoes!

**Extra:** If my brother and I were play, the cost of the shoes would be the same, but we'd have to pay it 2 times and the price of each game would be the same, but we'd have to pay that 2 times too. So, our linear equation would be similar, but  $m$  and  $b$  would be twice as much:

$$y = 6.50x + 1.50$$



If we had \$50, we could put that in for  $y$  and see how many games ( $x$ ) we could play.

$$50 = 6.50x + 1.50$$

$$48.50 = 6.50x$$

$$7.46 = x$$

Hmm...I don't think we could play 7.46 games – since we can't play a part of a game, so I think we could each play 7 games. Let me check.

$$y = 6.50(7) + 1.50 \text{ (this should be less than 50 if 7 games each is correct)}$$

$$y = \$47$$

Yep! That works, we'd have \$3 extra which would not pay for another game for both of us (or even one of us).

### METHOD 3: LOGICAL REASONING

1 & 2. I want to find a linear equation that represents the cost of bowling. I have two pieces of information:

- 3 games is \$10.50
- 5 games is \$17.00

My equation will be:

$$\text{Total Cost} = \text{Price Per Game} * \text{Number of Games} + \text{Shoe Rental Cost}$$

I need to find out the Price Per Game and the Shoe Rental Cost.

I noticed that when you play 2 more games, the price goes up by \$6.50, since  $\$17.00 - \$10.50 = \$6.50$ . If 2 more games increases the price by \$6.50, that means that each game increases the price by \$3.25, since  $\$6.50 \div 2 = \$3.25$ .

Now I need to find the cost of the shoes. In the 3 game situation the total cost is \$10.50. The three games alone cost \$9.75 because  $3 * \$3.25 = \$9.75$ . The difference in the total cost and the cost of 3 games alone must be the cost of shoes.  $\$10.50 - \$9.75 = \$0.75$ . The cost of shoe rental alone is \$0.75.

I can use those two facts to write a linear equation.

$$\text{Let } y = \text{Total Cost}$$

$$\text{Let } x = \text{Number of Games}$$

$$\text{Total Cost} = \text{Price Per Game} * \text{Number of Games} + \text{Shoe Rental Cost}$$

$$y = \text{Price Per Game} * x + \text{Shoe Rental Cost}$$

$$y = 3.25x + 0.75$$

3. To figure out how many games I can play with \$30, I can use my linear equation:

$$30 = 3.25x + 0.75$$

$$29.25 = 3.25x$$

$$9 = x$$

I can play 9 games exactly if I have \$30, this includes the price of my shoes!