6.4 Percent of Increase/Decrease

Occasionally we read news like the following:

- Cisco posted a good earning season and its stock increased by 2.5% yesterday.
- Since the recession, the population in this town has decreased by about 30%.

In this lesson, we will learn percent of increase/decrease. Here is the key: For percent of increase/decrease, we are talking about the increase/decrease with respect to the *original* value.

6.4.1 Calculate Percent of Increase/Decrease

Example 6.4.1 Mary just got a pay raise from \$15.00 per hour to \$15.75 per hour. What was the percent of increase?

Solution **Method 1:** First, we find the amount of increase by subtraction: \$15.75—\$15.00 =\$0.75. Next, we need to find \$0.75 is what percent of the *original* value—\$15.00. This is a Type II percent problem. We will use the Percent Formula to solve this problem.
Assume 0.75 is x (as a percent) of 15. We will write down the "Percent Formula" and the problem right next to each other:

$$\begin{array}{ccccc} 3 & = & 50\% & \cdot & 6 \\ 0.75 & = & x \text{ (as a percent)} & \cdot & 15 \end{array}$$

Next, we can solve for x in the equation:

$$\begin{aligned} 0.75 &= x \cdot 15 \\ 0.75 &= 15x \\ \frac{0.75}{15} &= \frac{15x}{15} \\ 0.05 &= x \\ 5\% &= x \end{aligned}$$

Conclusion: Mary got a 5% pay raise.
Method 2: First, we find the new pay rate, \$15.75, is what percent of the old pay rate, \$15.00. This is a Type II percent problem. Assume 15.75 is x (as a percent) of 15. We can solve the following equation:

$$\begin{aligned} 15.75 &= x \cdot 15 \\ 15.75 &= 15x \\ \frac{15.75}{15} &= \frac{15x}{15} \\ 1.05 &= x \\ 105\% &= x \end{aligned}$$

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The new pay rate is 105% of the old pay rate, implying the percent of increase is $105\% - 100\% = 5\%$.
Conclusion: Mary got a 5% pay raise.

Example 6.4.2 Since the recession, a town's population decreased from 279 to 221. What's the percent of decrease? Round your percent to a whole number.

Solution **Method 1:** First, we find the amount of decrease by subtraction: $279 - 221 = 58$.
Next, we need to find 58 is what percent of the *original* value—279. This is a Type II percent problem. We will use multiplication/division to solve this problem.
No variable (x) is involved in this method. The key is to write down a simple example on scratch paper, and then put numbers in their corresponding places.
To find "3 is what percent of 6", we do:

$$3 \div 6 = 0.5 = 50\%$$

Similarly, to find "58 is what percent of 279", we do:

$$58 \div 279 \approx 0.21 \approx 21\%$$

Conclusion: The town's population decreased by approximately 21%.
Method 2: First, we find 221 is what percent of the *original* value—279. This is a Type II percent problem. We have:

$$221 \div 279 \approx 0.79 \approx 79\%$$

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Since the new value is 79% of the original value, the percent of decrease is $100\% - 79\% = 21\%$.
Conclusion: The town's population decreased by approximately 21%.
Sometimes the increase is over 100%.

Example 6.4.3 Mary used to make $12.00 per hour. After she earned a Bachelor's degree, she found a new job which pays $33.00 per hour. What was the percent of increase in her pay?

Solution **Method 1:** First, we find the amount of increase by subtraction: $33.00—$12.00 =$21.00.
Next, we need to find $21.00 is what percent of the *original* value—$12.00. This is a Type II percent problem. We will use the Percent Formula to solve this problem.
Assume 21 is x (as a percent) of 12. We will write down the "Percent Formula" and the problem right next to each other:

$$\begin{array}{ccccc} 3 & = & 50\% & \cdot & 6 \\ 21 & = & x \text{ (as a percent)} & \cdot & 12 \end{array}$$

Next, we solve for x in the equation:

$$\begin{aligned} 21 &= x \cdot 12 \\ 21 &= 12x \\ \frac{21}{12} &= \frac{12x}{12} \\ 1.75 &= x \\ 175\% &= x \end{aligned}$$

Conclusion: The increase in Mary's pay rate was 175%.
Method 2: First, we find the new pay rate, $33.00, is what percent of the old pay rate, $12.00. This is a Type II percent problem. Assume 33 is x (as a percent) of 12. We solve

the following equation:

$$\begin{aligned} 33 &= x \cdot 12 \\ 33 &= 12x \\ \frac{33}{12} &= \frac{12x}{12} \\ 2.75 &= x \\ 275\% &= x \end{aligned}$$

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The new pay rate is 275% of the old pay rate, implying the percent of increase is 275% − 100% = 175%.
Conclusion: The increase in Mary's pay rate was 175%.

6.4.2 Increase and Decrease in Succession

If a value increased and then decreased by the same percentage, the result is often counter-intuitive.

Example 6.4.4 A house was purchased for \$200,000.00. Last year, the house's value increased 5%, and then decreased 5%. What's the house's current value after the changes?

Solution Intuitively, the house's value didn't change, but intuition doesn't work sometimes.
First, the house's value increased 5% from \$200,000.00. To find 5% of \$200,000.00, we do:

$$5\% \cdot 200000 = 0.05 \cdot 200000 = 10000$$

After the increase, the house's value became \$200,000+\$10,000 =\$210,000.
Next, the house's value decreased 5% from \$210,000.00. To find 5% of \$210,000.00, we do:

$$5\% \cdot 210000 = 0.05 \cdot 210000 = 10500$$

After the decrease, the house's value becomes \$210,000−\$10,500 =\$199,500.
Conclusion: The house's current value after the changes is \$199,500.
The 5% decrease is more than the 5% increase, because the 5% decrease was with respect to a bigger value (after the increase). ■

6.4.3 More Challenging Percent of Increase/Decrease Problems

The key to do percent of increase/decrease questions is to think of this question: The new value is what percent of the original value?

Example 6.4.5 Your favorite sweater is on sale! With 30% markdown, the new price is \$49.00. What was the sweater's regular price (before the markdown)?

Solution After the 30% markdown, the new price is 70% of the original price. Now the question becomes: \$49.00 is 70% of what? This is a Type III percent problem. We will use the percent formula to solve this problem.
Assume 49 is 70% of x. We will write down the "Percent Formula" and the problem right next to each other:

$$\begin{array}{ccccc} 3 & = & 50\% & \cdot & 6 \\ 49 & = & 70\% & \cdot & x \end{array}$$

Next, we can solve for x in the equation:

$$\begin{aligned} 49 &= 70\% \cdot x \\ 49 &= 0.7x \\ \frac{49}{0.7} &= \frac{0.7x}{0.7} \\ 70 &= x \end{aligned}$$

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Conclusion: The sweater's regular price (before the markdown) is $70.00.

Example 6.4.6 A sweater's price was marked up by 30%. After the markup, its new price is $78.00. What was the sweater's price before the markup?

Solution After the 30% price markup, the new price is 130% of the original price. Now the question becomes: $78.00 is 130% of what? This is a Type III percent problem. We will use the percent formula to solve this problem.
Assume 78 is 130% of x. We will write down the "Percent Formula" and the problem right next to each other:

$$\begin{array}{ccccc} 3 & = & 50\% & \cdot & 6 \\ 78 & = & 130\% & \cdot & x \end{array}$$

Next, we solve for x in the equation:

$$\begin{aligned} 78 &= 130\% \cdot x \\ 78 &= 1.3x \\ \frac{78}{1.3} &= \frac{1.3x}{1.3} \\ 60 &= x \end{aligned}$$

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Conclusion: The sweater's price was $60.00 before the markup.