

Explain It!

Nadia lives in the town of Preston. Quinn lives in the town of Elm Ridge. Nadia and Quinn each claim that her respective town's population is growing more rapidly.

PRESTON
POPULATION LAST YEAR 3,387
POPULATION THIS YEAR 3,392

ELM RIDGE
POPULATION LAST YEAR 1,820
POPULATION THIS YEAR 1,826

Lesson 3-4

Solve Percent Change and Percent Error Problems

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I can...
solve problems involving percent change and percent error.

A. Write an argument to support Nadia. Why might she argue that Preston's population is growing more rapidly?

B. Write an argument to support Quinn. Why might she argue that Elm Ridge's population is growing more rapidly?

C. Whose reasoning is more logical? Explain why.

Focus on math practices

Critique Reasoning Suppose Preston's population is expected to grow 3% next year. Nadia says that means the population will increase by 300 people. Is Nadia's reasoning correct? Explain.

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Essential Question

How is finding percent error similar to finding percent change?

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EXAMPLE 1 Find Percent Increase

The **percent change** describes how much a quantity has changed relative to its original amount. The percent change can be an increase or decrease. What is the percent change of the alligator's length?

Model with Math What representation can show the change in the alligator's length?

STEP 1 Draw a bar diagram to represent the percent change from last year to this year.

The percent change is a **percent increase** because the alligator's length increased.

% change

32 inches 6 in.

32 inches

100%

The change in length is 6 inches.

STEP 2 Use the percent equation to find the percent change.

$$\text{part} = \text{percent} \cdot \text{whole}$$

$$\frac{\text{change in length}}{32} = \frac{\text{percent}}{100} \cdot 32$$

$$6 = P \cdot 32$$

$$\frac{6}{32} = P$$

$$0.1875 = P$$

Express the decimal as a percent by multiplying by 100.

The alligator's length increased by 18.75% this year.

Try It!

What will be the length of the alligator next year if its length changes by the same percent as it changed this year?

percent change \cdot length this year = change in length

$$0.1875 \cdot \square = \square$$

$$\square + \square = \square$$

Next year, the length of the alligator will be inches long.

Convince Me! Why is the increase in the alligator's length different from year to year, even though the percent change stayed the same?

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EXAMPLE 2 Find Percent Decrease

Last year, a website had 40,000 visitors and this year, it had 37,000 visitors. What is the percent change in the number of visitors to the website from last year to this year?

Find the decrease in the number of visitors. Then use the percent equation to find the percent change.

The percent change is a percent decrease because the number of visitors decreased.



change in number of visitors = percent change · number of visitors last year

$$3,000 = P \cdot 40,000$$

$$\frac{3,000}{40,000} = P$$

$$0.075 = P$$

The number of visitors decreased by 7.5% this year.

EXAMPLE 3 Find Percent Error

Shaun estimated that the attendance at a college lacrosse game was 3,000. The actual attendance was 3,296. What is the percent error of Shaun's estimate? Round to the nearest whole percent.

Percent error describes the accuracy of a measured or estimated value compared to an actual value. It is always a positive percent.

Use absolute value to find the positive difference between the estimated and actual attendance. Then use the percent equation to find the percent error.

$$|3,000 - 3,296| = 296$$

difference in attendance = percent error · actual attendance

$$296 = P \cdot 3,296$$

$$\frac{296}{3,296} = P$$

$$0.0898 = P$$

Remember to express the decimal value as a percent.

Shaun's attendance estimate has a percent error of about 9%.

Try It!

The specification for the length of a bolt is 4.75 inches. A machinist makes a bolt that is 4.769 inches long. What is the percent error of the bolt's length?



KEY CONCEPT $\% \text{ change} = \frac{\text{new} - \text{old}}{\text{old}}$

Percent change and percent error problems are kinds of percent problems. You can use the percent equation to solve them.

The amount of change is the difference between original and new values.

Do You Understand?

- Essential Question** How is finding percent error similar to finding percent change?
- Reasoning** Give an example of a problem in which the percent error is greater than 20%, but less than 50%. Explain how you determined the percent error.

Do You Know How?

- Lita's softball team won 10 games last month and 8 games this month. What was the percent change in games the team won? Was it an increase or decrease? $\frac{10 - 8}{8} = \frac{2}{8} = \frac{1}{4} = 25\%$
- What is the percent change in the price of a gallon of gas, to the nearest whole percent? Is it an increase or a decrease? $\frac{3.499 - 3.079}{3.079} = \frac{0.42}{3.079} \approx 13.6\%$
- Several students measured a 25-mm-long nail and wrote the measurements shown in the table below. Whose measurement had the greatest percent error? Round to the nearest percent.

Student	Measurement (mm)	Percent Error
Layne	26	<input type="checkbox"/>
Tenicia	23	<input type="checkbox"/>
Juan	25	<input type="checkbox"/>

Handwritten Notes:

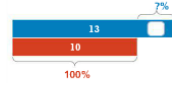
- $10\% = 1.0 = 1$
- $20\% \text{ of } \$10 = \2
- $20\% \times 10 = 2$
- $\text{Cost} = 10 + 2 = 12$
- $20\% \text{ of } \$12 = 2.4$
- $10\% \text{ rule} = 1.2$
- $20\% = 1.2 \times 2 = 2.4$ (markdown)
- $\begin{array}{r} 12.00 \\ - 2.40 \\ \hline 9.60 \end{array}$
- $\$90$
- $10\% = \$9$
- $20\% = \$18$
- $\$60$
- $10\% = \$6$
- $20\% = \$12$

Name: _____

Practice & Problem Solving

Leveled Practice In 7-8, use the bar diagram and fill in the boxes to solve.

7. The original quantity is 10 and the new quantity is 13. What is the percent change? Is it an increase or decrease?



$\square = p \cdot \square$
 $\square = p$
 The percent increase is \square %.

8. The original quantity is 5 and the new quantity is 3. What is the percent change? Is it an increase or decrease?



$\square = p \cdot \square$
 $\square = p$
 The percent decrease is \square %.

9. At noon, a tank contained 10 cm of water. After several hours, it contained 7 cm of water. What is the percent decrease of water in the tank?

11. Carl bought an airline ticket. Two weeks ago, the cost of this flight was \$300.



What is the percent increase?

10. Craig likes to collect vinyl records. Last year he had 10 records in his collection. Now he has 12 records. What is the percent increase of his collection?

12. On Monday, a museum had 150 visitors. On Tuesday, it had 260 visitors.

- a. Estimate the percent change in the number of visitors to the museum.
 b. About how many people would have to visit the museum on Wednesday to have the same percent change from Tuesday to Wednesday as from Monday to Tuesday? Explain your answer.

** error = actual*

%. error = $\frac{\text{measured} - \text{actual}}{\text{actual}}$

%. error = $\frac{2.1 - 1.5}{1.5} = \frac{0.6}{1.5} = 0.4 = 40\%$

d to %.

40% error

15. A band expects to have 16 songs on their next album. The band writes and records 62.5% more songs than they expect to have in the album. During the editing process, 50% of the songs are removed. How many songs will there be in the final album?

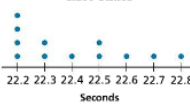
62.5% of 16
 $62.5 \times 16 = 1000$
more songs

16. **Make Sense and Persevere** In the first week of July, a record 1,060 people went to the local swimming pool. In the second week, 105 fewer people went to the pool. In the third week, 135 more people went to the pool than in the second week. In the fourth week, 136 fewer people went to the pool than in the third week.

What is the percent change in the number of people who went to the pool between the first and last weeks?

18. **Higher Order Thinking** The dot plot shows predictions for the winning time in a 200-meter sprint. The winner finished the race in 22.3 seconds. Find the greatest percent error for a prediction to the nearest tenth of a percent. Justify your answer.

Race Times



17. **Be Precise** You have 20 quarters. You find 40% more quarters in your room. Then you go shopping and spend 50% of the total number of quarters.

40% of 20
 $40\% = 8$
we found an extra 8 quarters for shopping.
 $20 + 8 = 28$
 $\frac{1}{2}$ of 28 = 14 spend 8 quarters
 14 keeping in your room.

16 + 10 = 26 total songs

removed 50% of 26

$\frac{1}{2} \times 26$

13 songs removed
 $26 - 13 = 13$

13 songs made the final album.

Assessment Practice

19. The amount of money in a savings account increases from \$250 to \$270. What is the percent increase of the money in the savings account?

20. A meteorologist predicted that there would be 10 inches of snowfall from a snowstorm. Instead, there were 22 inches of snowfall. Which of the following statements is true? Select all that apply.

- The prediction was off by 35%.
- If the percent error should be less than 60%, the prediction was acceptable.
- The percent error of the prediction was about 55%.
- If the percent error should be less than 20%, the prediction was acceptable.
- The difference between the predicted and actual snowfall was 12 inches.

