Lesson 6-4
Percent of Change

Interactive Study Guide
See pages 135–136 for:
- Getting Started
- Real-World Link
- Notes

Essential Question
How can you use proportional relationships to solve real-world percent problems?

Common Core State Standards
Content Standards
7.RP.3, 7.EE.2, 7.EE.3
Mathematical Practices
1, 3, 4, 6

Vocabulary
percent of change
percent of increase
percent of decrease
percent error

What You'll Learn
- Find percent of increase and decrease.
- Find percent error.

Real-World Link
Movies Movies sure have come a long way! The first known motion picture was filmed in 1888 and lasted for only 2.11 seconds. Today, we watch motion pictures that last an average of about two hours. The price to go to a movie has also gone up. In 1948, the average ticket price was \$0.36. In 2012, the average went up to \$7.93.

Key Concept Percent of Change

Words	A **percent of change** is a ratio that compares the change in quantity to the original amount.
Symbols	$\text{percent of change} = \frac{\text{amount of change}}{\text{original amount}}$ ENDING − START / STARTING AMOUNT

If the percent is positive, the percent of change is a **percent of increase**. If the percent is negative, the percent of change is called a **percent of decrease**.

Example 1

Tools Tutor

Find the percent of change from 60°F to 84°F. Then state whether the percent of change is an *increase* or a *decrease*.

Step 1 Subtract to find the amount of change.

$84 - 60 = 24$ final amount − original amount

Step 2 $\text{percent of change} = \frac{\text{amount of change}}{\text{original amount}}$ Write a ratio that compares the amount of change to the original amount.

$= \frac{24}{60}$ Substitution

$= \frac{2}{5}$ or 0.4 Simplify.

Step 3 The decimal 0.4 is written as 40%. So, the percent of change is 40%. Since the percent of change is positive, it is a percent of increase.

Got It? Do this problem to find out.

1. Ty had 52 comic books. Now he has 61 books. Find the percent of change. Round to the nearest tenth, if necessary. Then state whether the percent of change is an *increase* or a *decrease*.

$\frac{9}{52} = 0.17$ ↑ 0.2 OR 20% INCREASE

Jasper White CM/Image Source

Watch Out!
When finding percent of change, don't assume the smaller number is the whole. When the percent of change is a decrease, the original amount will be larger than the new amount.

Example 2

Tools Tutor

McKenna had 318 stamps. Now she has 273 stamps. Find the percent of change. Round to the nearest tenth, if necessary. Then state whether the percent of change is an *increase* or a *decrease*.

$$\text{percent of change} = \frac{\text{amount of change}}{\text{original amount}}$$

$$= \frac{273 - 318}{318} \qquad \frac{\text{final amount} - \text{original amount}}{\text{original amount}}$$

$$= -\frac{45}{318} \qquad \text{Simplify.}$$

$$\approx -0.141509 \qquad \text{Divide. Use a calculator.}$$

To the nearest tenth, the percent of change is −14.2%. Since the percent of change is negative, it is a percent of decrease.

24 - 18 = 6 $\quad \frac{6}{24} = 0.25$ 25% DECREASE

Got It? Do this problem to find out.

2. Find the percent of change from 24 points to 18 points. Then state whether the percent of change is an *increase* or a *decrease*.

18 - 24 = -6 $\quad \frac{-6}{24} = -0.25 = 25\%$ DECREASE

Key Concept Percent Error

Words	The **percent error** is a measure of the difference between an estimate, prediction, or measurement and the actual value.
Symbols	$\text{percent error} = \frac{\text{amount of error}}{\text{actual value}} \times 100$

The amount of error is nonnegative when calculating percent error.

Example 3

Tutor

Alyssa estimates that her school auditorium has 660 seats. It actually has 750 seats. What is the percent error of her estimate?

Step 1 Find the amount of error.

$660 - 750 = -90$ Subtract the actual value from the estimate.

$|-90| = 90$ Find the absolute value of the difference.

Step 2 Find the percent error.

$\frac{90}{750} \times 100 = 0.12$ $\quad \frac{\text{amount of error}}{\text{actual value}} \times 100$

ACTUAL

The percent error is 12%.

Got It? Do these problems to find out.

Find the percent error. Round to the nearest tenth, if necessary.

3a. estimated weight: 8 pounds, actual weight: 6.4 pounds

3b. measured length: 2.5 centimeters, actual length: 2.54 centimeters

$\frac{0.04}{2.54} = 0.0157 = 1.6$

Guided Practice

Find the percent of change. Round to the nearest tenth, if necessary. Then state whether the percent of change is an *increase* or a *decrease*. (Example 1)

1. From $40 to $32
2. From 56 inches to 63 inches
3. **Financial Literacy** On Saturday, Smoothie Central made $1300 in sales. On Sunday, they made $900 in sales. What is the percent of change from Saturday to Sunday, and is it an increase or decrease? (Example 2)

Find the percent error. (Example 3)

4. estimated distance: 60 miles, actual distance: 75 miles
5. measured area: 24 square inches, actual area: 22.5 square inches
6. The estimate for the amount of rain in May in one part of Texas was 5.6 inches. The actual rainfall was 2.4 inches. What was the percent error of the estimate to the nearest percent?

Independent Practice

Go online for Step-by-Step Solutions

Find the percent of change. Round to the nearest tenth, if necessary. Then state whether the percent of change is an *increase* or a *decrease*. (Example 1)

7. From 14 inches to 26 inches
8. From $36 to $48
9. From 82 feet to 74 feet
10. From 16 kilograms to 5 kilograms
11. From $128 to $112
12. From 90 yards to 72 yards
13. From 191 ounces to 270 ounces
14. From 150 minutes to 172 minutes
15. A survey of gas prices in January showed that the cost per gallon one year was $2.649. The following January, the cost per gallon was $2.999. Find the percent change in gas prices from one year to the next to the nearest tenth. (Example 2)
16. Jerome High School's football team scored 38 points in their first game. The next week, they only scored 17 points. Find the percent change in the number of points scored by the football team to the nearest tenth. (Example 2)

Find the percent error. (Example 3)

17. actual height: 180 meters, estimated height: 200 meters
18. estimated time: 40 workdays, actual time: 80 workdays
19. projected cost: $1250, actual cost: $2000
20. actual number: 384, calculated number: 385
21. **STEM** A megabyte is 1024 kilobytes of data. Kevin incorrectly used 1000 instead of 1024. What was the percent error of his calculation to the nearest hundredth? (Example 3)
22. A bottle of vitamins should have 60 vitamins. The actual number is 62. What is the percent error to the nearest hundredth? (Example 3)
23. For a local telethon 3860 viewers called in and donated money on the first night. The next night, there was a 20% decrease in the number of calls from the first night. How many calls did the telethon receive on the second night?
24. There were 10,651 athletes who participated in the Summer Olympics one year. Four years later, 11,099 athletes participated. What was the percent of change in the number of athletes participating from one Summer Olympics to the next? Round to the nearest tenth.

25. The number of people who participated in bicycle riding one year was 40.3 million. Two years later, the number was 35.6 million. Find the percent of change in the number of bicycle riders. Round to the nearest tenth.

26. **Be Precise** A company replaced its half-gallon container of orange juice with a 59-ounce container. If a customer does not notice the change in size, what is the percent error to the nearest tenth?

27 Torie's 400 meter dash time is 74 seconds. Juliette's time is 15% faster than Torie's. What is Juliette's 400 meter dash time? Write an inequality comparing the two times. Use the symbol $<$ or $>$.

28. Christopher Columbus calculated the distance from the Canary Islands to Japan to be 3700 kilometers. The actual distance is about 19,600 kilometers. What was the percent error of his calculation to the nearest percent?

29. **Financial Literacy** The first- and second-quarter earnings of two restaurants are shown at the right. Which restaurant had the greater percent of change in the second quarter?

Earnings ($)		
Quarter	A	B
1	17,821	8112
2	18,331	9920

30. Kyla's boxer weighs about 62 pounds. When it was a puppy it weighed 23 pounds. What is the percent of change in weight? Round to the nearest tenth.

31. **Multiple Representation** In this problem, you will compare percents of change. The table shows the population of capital cities for four different states.

City	Population 2000	Population 2006	Amount of Change	% of change
Raleigh, NC	276,093	356,321		
Columbia, SC	116,278	119,961		
Frankfort, KY	27,741	27,077		
Columbus, OH	711,470	733,203		

a. Table Copy and complete the table. Round to the nearest whole percent.

b. Analyze Compare the amounts of change and the percents of change for Columbia and Columbus. Explain the differences and similarities between the two.

H.O.T. Problems Higher Order Thinking

32. **Model with Mathematics** Give a real-world example of a percent of increase.

33. **Model with Mathematics** Find an actual measurement and a calculated measurement where the percent error of the calculation is 5%.

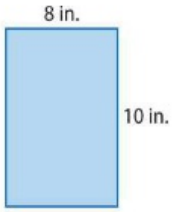
34. **Make a Conjecture** What happens when you find the percent error when the actual value is 0? Explain your reasoning to a classmate.

35. **Persevere with Problems** A tool is manufactured so that the mean diameter is 250 millimeters with a percent of error of no more than 2%. What are the smallest and largest diameters that are acceptable?

36. **Building on the Essential Question** The student population was 1600 and was predicted to rise 10% in five years. It rose 15% instead. Find the predicted and actual populations and describe the percent error.

Standardized Test Practice

37. If each dimension of the rectangle is tripled, what is the percent of increase in the area?



A 300%
C 800%
B 600%
D 900%

38. Which of the following represents the greatest percent of change?

F Boots that were originally priced at $90 are on sale for $63.

G A baby that weighed 7 pounds at birth now weighs 10 pounds.

H A bracelet that costs $12 to make is sold for $28.

J A savings account increased from $500 to $600 in 1 year.

39. The table shows the budget of a city.

Annual Budget	
Year	Budget (millions of $)
2009	45.6
2010	48.3
2011	45.9
2012	55.1

Which statement is supported by the table?

A The budget decreased and then increased.

B The greatest percent of change occurred from 2009 to 2010.

C The budget increased 20% from 2011 to 2012.

D The percent of change from 2009 to 2010 was the same as from 2010 to 2011.

40. **Short Response** A football team was predicted to win 5 games this year. The team won 12 games. What was the percent error of the prediction?

Common Core Review

Solve each problem using the percent equation. 7.RP.2

41. Find 12% of 72.

42. Find 42% of 150.

43. What is 37.5% of 89?

44. What is 24.2% of 60?

45. Suppose fifty-six percent of the Calories in corn chips are from fat. If one serving contains 160 Calories, estimate the number of Calories from fat in one serving of corn chips. 7.RP.3

46. Of the fish in an aquarium, 26% are angelfish. If the aquarium contains 50 fish, how many are angelfish? 7.RP.3

Find each sum. Write in simplest form. 7.NS.1d

47. $\frac{1}{10} + \frac{1}{3}$

48. $-\frac{1}{6} + \frac{7}{18}$

49. $6\frac{4}{5} + \left(-1\frac{3}{4}\right)$

Write each fraction as a decimal. 7.NS.2d

50. $\frac{7}{8}$

51. $\frac{1}{5}$

52. $\frac{6}{20}$

53. $\frac{45}{50}$

Find each sum or difference. 7.NS.1

54. $-12 - (-15)$

55. $-25 + 15$

56. $-2 - 20$