



# Measuring the percentage of change

In this lesson students learn that prices and income do not remain static, but instead change over time. They learn how to compare income or the price of an object at two different points in time and learn how changes in income or price affect a person's purchasing power. The examples in this lesson relate to income and the price of housing.

## Objectives

Students will:

- Practice pre-algebra skills by:
  - Calculating percent change between data points.
  - Converting fractions to decimals.
- Create bar graphs to communicate the significance of changes.
- Understand that wages and prices are not static but instead change over time.
- Understand how disparate changes in income verses home prices can affect people's ability to buy homes.

## Math content standards

Algebra

- Use mathematical models to represent and understand quantitative relationships.
- Analyze change in various contexts.

Data analysis and probability

- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.

Representation

- Use representations to model and interpret physical, social, and mathematical phenomena.

## Materials:

- "Calculating percentage of change"
- "Methods of comparing change: Port St. Lucie"
- "Extra practice problems" (Using U.S. housing data)

## Procedure:

### 1. Practice calculating percentage of change.

Distribute the worksheet "Calculating percentage of change." Review the first example together and do the rest of the worksheet together in class. Be sure to explain that:

- Percentage of change is a useful tool for understanding whether the price of an object has changed a lot or a little.
- Percentage of change can be positive or negative, meaning that the numbers can have gone up (positive) or down (negative).
- Zero percent change means the price stayed the same—that there was no change.
- 100 percent change in price means that the price of object doubled.

### 2. Calculate percentage of change using real data on income and home prices.

Distribute the worksheet "Methods of comparing change." Have students calculate the percentage of change of income and home prices in Port St. Lucie. Begin by reviewing the table of information and discussing the questions with the class. Be sure to discuss the term median, as well as the following:

- *What does the term "median income" mean?*  
If you line up all the salaries that people make in order, from smallest to largest, the number that is in the middle of the data set is the median income. The "median income" is meant to give you an idea of what a typical person in the community earns.

## Technology

You may opt to have students calculate the percentage of change for the worksheets or create their bar graph by using a computer spreadsheet program.

- *What does “median home price” mean?*  
If you line up the prices of all homes in an area in order, from smallest to largest, the number in the middle of the data set is the median price of a home in that area. The “median home price” is meant to give you an estimate of how much a typical home in the area costs.
- *Why do you think the income and prices changed?*  
Prices and salaries change over time due to inflation (the value of the dollar falls over time). Something that cost \$1 today will probably cost more dollars 20 years from now and even more dollars 50 years from now. For example, look at the price changes for three basic items between 1998 and 2008<sup>1</sup>:

	1998	2008
Dozen eggs	\$1.12	\$2.18
1 lb. of apples	\$0.92	\$1.16
Gallon of milk	\$2.70	\$3.83

### 3. Create bar graphs to display the data.

Have students create a bar graph showing the 1998 data and the 2006 data. Help students analyze their bar graph. Did it get harder or easier for a person to buy a home in 2006 versus 1998?

#### *Extra practice problems:*

Included in this lesson are extra problems you can provide your students to practice calculating percentage of change and creating bar graphs. The data comes from the U.S. census at <http://www.census.gov/hhes/www/income/histinc/state/state1.html>. The data is given in current U.S. dollars (dollar values of the year the data was reported).

If you want to have students look up information on median home prices and median income in your own state or county for the last census date, these two websites may be useful:

- Quick facts site from the U.S. census: <http://quickfacts.census.gov/qfd/>
- County and city data from City-Data.com: <http://www.city-data.com/>

### 4. Discuss the widening gap between median income and median home price, and the impact it has on people’s ability to buy homes.

In the past decade in the United States, the median price of homes has risen much faster than the median income. Ask students what this means for the average American. They should come to the conclusion that it has become harder for someone to buy a home during this time period.

Habitat for Humanity is one of several organizations that work to make housing more affordable. Habitat loans money to lower income families with no-profit charges. This makes it easier for the families to repay the loan over time. In addition, Habitat builds simple, decent, low-cost homes for the families to purchase with the loans. Families are also required to do “sweat equity,” helping build their own home and homes for other Habitat for Humanity homeowners. Through organizations like HFH, American families can hope to own their own homes despite a rising disparity between income and the price of a home. Habitat also helps families around the world into simple, decent, affordable housing. For more information on Habitat for Humanity, see <http://www.habitat.org>.

## Calculating percentage of change

### Example:

Tom's house cost \$100,000 in the year 2000. In 2008 he sold his house for \$125,000.

- By how many dollars did the price change? \_\_\_\_\_
- Was the change in price a positive or negative change?  
POSITIVE or NEGATIVE
- What was the percentage of change in the price of the house?

$$\frac{\text{Change in Price}}{\text{Original Price}} = \frac{25,000}{100,000} = \frac{25}{100} = 0.25 = 25\%$$

### Problem 2:

Jordan's house cost \$100,000 in the year 2000. In 2008 she sold it for \$90,000.

- By how many dollars did the price change? \_\_\_\_\_
- Was the change in price a positive or negative change?  
POSITIVE or NEGATIVE
- What was the percentage of change in the price of the house?

$$\frac{\text{Change in Price}}{\text{Original Price}} =$$

### Problem 1:

Rebecca's house cost \$100,000 in the year 2000. In 2008 she sold it for \$210,000.

- By how many dollars did the price change? \_\_\_\_\_
- Was the change in price a positive or negative change?  
POSITIVE or NEGATIVE
- What was the percentage of change in the price of the house?

$$\frac{\text{Change in price}}{\text{Original price}} =$$

### Problem 3:

Matthew's house cost \$45,000 in the year 2000. In 2008 he sold it for \$60,000.

- By how many dollars did the price change? \_\_\_\_\_
- Was the change in price a positive or negative change?  
POSITIVE or NEGATIVE
- What was the percentage of change in the price of the house?

$$\frac{\text{Change in Price}}{\text{Original price}} =$$

Teacher's copy

## Calculating percentage of change

### Example:

Tom's house cost \$100,000 in the year 2000. In 2008 he sold his house for \$125,000.

- By how many dollars did the price change? By \$25,000
- Was the change in price a positive or negative change? POSITIVE or NEGATIVE
- What was the percentage of change in the price of the house?

$$\frac{\text{Change in Price}}{\text{Original Price}} = \frac{25,000}{100,000} = \frac{25}{100} = 0.25 = 25\%$$

### Problem 2:

Jordan's house cost \$100,000 in the year 2000. In 2008 she sold it for \$90,000.

- By how many dollars did the price change? By -\$10,000
- Was the change in price a positive or negative change? POSITIVE or NEGATIVE
- What was the percentage of change in the price of the house?

$$\frac{\text{Change in Price}}{\text{Original Price}} = \frac{-10,000}{100,000} = \frac{-10}{100} = -0.1 = -10\%$$

### Problem 1:

Rebecca's house cost \$100,000 in the year 2000. In 2008 she sold it for \$210,000.

- By how many dollars did the price change? By \$110,000
- Was the change in price a positive or negative change? POSITIVE or NEGATIVE
- What was the percentage of change in the price of the house?

$$\frac{\text{Change in price}}{\text{Original price}} = \frac{110,000}{100,000} = \frac{110}{100} = 1.10 = 110\%$$

### Problem 3:

Matthew's house cost \$45,000 in the year 2000. In 2008 he sold it for \$60,000.

- By how many dollars did the price change? By \$15,000
- Was the change in price a positive or negative change? POSITIVE or NEGATIVE
- What was the percentage of change in the price of the house?

$$\frac{\text{Change in Price}}{\text{Original price}} = \frac{15,000}{45,000} = \frac{15}{45} = .33 = 33\%$$

## Methods of comparing change: Port St. Lucie

Here is some housing data for Port St Lucie, Florida, one of fastest growing cities in the United States.

Port St. Lucie, FL	1998	2006	Percentage of change
Median Income	\$44,500	\$54,600	
Median Home Price	\$78,400	\$257,500	

The formula for calculating the percentage of change between two prices is:

$$\text{Percentage of Change} = \frac{(\text{New Price} - \text{Original Price})}{\text{Original Price}}$$

What was the percentage of change in median income between the years 1998 and 2006?

What was the percentage of change in median home price between the years 1998 and 2006?

**Directions for creating a bar graph:**

Create a bar graph that shows the median income and the median home price for Port St. Lucie in the year 1998 and in the year 2000. Follow these steps:

- Draw an X axis and a Y axis.
- What will you label the Y axis?
- What will you label the X axis?
- Plot the two years on the X axis.
- Plot the four dollar values on the Y axis.
  - Start by labeling the bottom of the Y axis as zero. The top of the Y axis should be slightly higher than the largest dollar value in your data set. Choose a round number to make it easier to plot other reference points.
  - Draw more reference points on the Y axis.
  - Now plot the four dollar values on the Y axis.
- Plot the points for the year 1998:
  - Plot the point for the median income in 1998. Draw a column from this point down to the X axis.
  - Plot the point for the median home price in 1998. Draw a column from this point down to the X axis.
- Plot the points for the year 2000:
  - Plot the point for the median income in 2000. Draw a column from this point down to the X axis.
  - Plot the point for the median home price in 2000. Draw a column from this point down to the x axis.

**Discussion questions:**

1. Does the graph show a positive or negative change in median income?
2. Does the graph show a positive or negative change in median home price?
3. Which change was larger?
4. Compared to the change in median income, was the change in median home price large or small?
5. How did these changes affect people in Port St. Lucie who wanted to buy a home in 1998 compared to people who wanted to buy a home in 2000?
6. Why do you think prices of homes in Port St. Lucie rose so much?

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## Methods of comparing change: Port St. Lucie

Here is some housing data for Port St Lucie, Florida, one of fastest growing cities in the United States.

Port St. Lucie, FL	1998	2006	Percentage of Change
Median Income	\$44,500	\$54,600	22.6 %
Median Home Price	\$78,400	\$257,500	228 %

The formula for calculating the percentage of change between two prices is:

$$\text{Percentage of Change} = \frac{(\text{New Price} - \text{Original Price})}{\text{Original Price}}$$

What was the percentage of change in median income between the years 1998 and 2006?

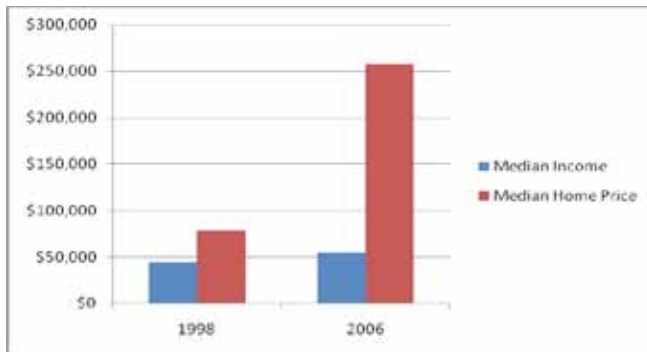
$$\text{Percentage of Change} = \frac{(54,600 - 44,500)}{44,500} = \frac{10,100}{44,500} = 0.226 = 23\%$$

What was the percentage of change in median home price between the years 1998 and 2006?

$$\text{Percentage of Change} = \frac{(257,500 - 78,400)}{78,400} = \frac{179,100}{78,400} = 2.28 = 228\%$$

**Directions for Creating a Bar Graph:**

The bar graph should look like the following:

**QUESTIONS:**

- Does the graph show a positive or negative change in Median Income?  
**Positive**
- Does the graph show a positive or negative change in Median Home Price?  
**Positive**
- Which change was larger?  
**Change in Median Home Price**
- Compared to the change in Median Income, was the change in Median Home Price large or small?  
**It was a large change.**
- How did these changes affect people in Port St. Lucie who wanted to buy a home in 1998 compared to people who wanted to buy a home in 2006?  
**The prices in 2006 were much higher than the prices in 1998, which made buying a home more expensive than eight years before.**
- Thinking question: Why do you think prices of homes in Port St. Lucie rose so much?  
**Between 1998 and 2006 many people decided to buy homes, meaning there was a high demand for buying homes. This made the prices higher, because supply was probably not able to keep up with the demand at that rate of increase.**

## Extra practice problems

Here is some housing data for the United States as a whole.

National Data for U.S.	1980	1990	2000	2006
Median Income	\$16,841	\$30,056	\$41,994	\$48,023
Median Home Price	\$93,400	\$101,100	\$119,600	\$257,500

**Plot the Median Income and the Median Home Prices on a graph.**

1. Do the changes in Income and Home Price change at the same rate?
2. Between what years did Median Income change the most?
3. Between what years did Median Home Price change the most?
4. What is the percentage of change in Median Income from 1980 to 2006?
5. What is the percentage of change in Median Home Price from 1980 to 2006?
6. Is it easier for a household with Median Income to afford a home in 1980 or in 2006?