LESSON 1.4

Structure of Expressions

Common Core State Standards

A-SSE.1 Interpret parts of an expression, such as terms, factors, and coefficients.

Mathematical Practices 1, 4, 7

CAREER SPOTLIGHT: Economics Professor

Economics professors are postsecondary teachers who use math and social science related to economic studies. This career includes not only instruction of students in economics but also research of a variety of topics in economics. Some professors focus their research on improving the efficiency of economic policies.

- Discuss postsecondary teaching with students by reading the Career Spotlight together.
- Find local colleges and universities with an economics program to share with students.
- Research colleges and universities that employ economics professors, and ask professors what they do in addition to teaching.

Video: Economics Professor

Have students watch this video, which describes the types of tasks an economics professor might do.

Lesson Objective

In this lesson, you will look at how an economics professor uses expressions and formulas and interprets terms, coefficients, and factors in those expressions and formulas.

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Teaching Support

1 Step Into the Career: Labor Force and Unemployment Rates

An economics professor is researching unemployment in a small country. The total labor force is the number of adults of working age who are working or actively looking for work. Unemployed people are those who do not have a job but are looking for a job. The unemployment rate is the percent of people in the labor force who are unemployed. The labor force participation rate is the percent of adults of working age who are in the labor force.

How can the professor write an expression to describe the number of unemployed people? Interpret the terms and coefficients.

Month	Total Number of Working-Age Adults	Rate of Working-Age Adults Who Have a Job	Rate of Working-Age Adults Who Are Not in the Labor Force
June 2019	2,195,437	b	c

Guiding Questions

- In the table, how do the variable rates relate to the total number of working-age adults?
- In the table, how do the groups represented by each column relate to the number of unemployed people?
- In Step 3, what do you notice about the coefficients in the expression? How can you use the distributive property to rewrite the expression?

TECHNOLOGY Have students research labor statistics for each month in the past year. Encourage them to use a spreadsheet to organize and calculate the rates of labor participation and unemployment.

On the Job: Apply Labor Force and Unemployment Rates

Answers

1a. the labor force participation rate

1b. the unemployment rate times the labor force participation rate, or the fraction of working-age adults who are unemployed

1c. the number of working-age adults in the state who do not have a job, or the unemployed population plus the working-age adults not in the labor force

Use these questions to check students' understanding.

- In 1a, how did you recognize the percent rewritten as a decimal?
- In 1b, how did you recognize the product of two percents written as a decimal?
- In 1c, what term represents the percent of people unemployed?
- How does the number of working-age adults who are not in the labor force compare with the number who are in the labor force?

2 Step Into the Career: Price Inflation

An economist is studying inflation. The inflation rate is the increase in prices as a percent of the price at the starting point. The Consumer Price Index (CPI) is a measure used to describe the prices for a set of common goods and services. It approximates the prices that consumers pay each month for the goods and services we buy. Food and energy are listed separately because their prices fluctuate more.

How can you use the table to interpret the expressions on the left side of the equations $(212.982)(1 - x) = C$ and $(256.417)(1 + y) = B$?

	January 2019	December 2019	January 2020
CPI for All Goods and Services	251.712	256.974	*A*
CPI for Food Only	256.417	259.823	*B*
CPI for Energy Only	200.563	212.982	*C*
CPI for All Items Except Food and Energy	260.122	264.935	*D*

Guiding Questions

- How can you write a decimal as a percent?
- In which column and row do the variables and numbers lie?
- In Step 3, how can you interpret 1 minus a number or 1 plus a number when using rates?

DIFFERENTIATION: ENRICHMENT Have students research the CPI for the last month and compare it with the previous month and with the same month in the previous year. Encourage them to use a spreadsheet and write expressions or formulas to calculate the rates of inflation for each aspect of the CPI.

On the Job: Apply Price Inflation

Answers

2a. The factor (1 + 0.015) represents the ratio of the January 2020 CPI to the December 2019 CPI. The 0.015 represents a 1.5% change in the price of fruits and vegetables from December 2019 to January 2020.

2b. The factor (1 – 0.01) represents the ratio of the January 2020 CPI to the January 2019 CPI. The 0.01 represents a 1% change in the price of fruits and vegetables from January 2019 to January 2020.

2c. The plus sign in the expression in Part (a) means that inflation was 1.5% between December 2019 and January 2020. The minus sign in the expression in Part (b) means that inflation was –1% between January 2019 and January 2020.

Use these questions to check students' understanding.

- In 1a, how did you recognize the percent change in price?
- In 1b, how did you recognize the percent change in price?
- In 1c, how did you know when an expression represented a price increase and when it represented a price decrease?

Career Spotlight: Practice

Solution Steps for Exercises 3–6

These steps will help guide students in solving these practice exercises.

Exercise 3

Answers

3a. the selling price in dollars of each item

3b. the fixed cost in dollars for a year

3c. the cost in dollars to make each item

3d. The expression 18,500 + 11.75x represents the total cost to make x items in a year.

Solution Steps

- Profit = Revenue – Total Cost
- Total Cost = Fixed Cost + Variable Cost
- Profit = Revenue – (Fixed Cost + Variable Cost)
- Both the revenue and variable cost should include the variable x, which represents the number of items made and sold.

Exercise 4

Answers

4a. the change in the average hourly wage from January to May

4b. It changes the rate to a percent.

4c. the percent of increase in the average hourly wage from January to May

Solution Steps

- The numerator is a difference between two values from the table.
- The denominator is the average hourly wage in January.
- To write a ratio as a percent, multiply it by 100.

Exercise 5

Answer

5. B represents the number of unemployed people. A represents the number of employed people. $A + B$ represents the size of the labor force.

Solution Steps

- $\dfrac{B}{A+B} = \text{Unemployment Rate}$
- Labor Force = Unemployed + Employed
- $\dfrac{B}{A+B} = \dfrac{\text{Unemployed}}{\text{Labor Force}}$

Exercise 6

Answers

6a. a 32% change in CPI from April 2019 to April 2020

6b. The gasoline price index decreased by 32% from April 2019 to April 2020.

6c. $\dfrac{168.891}{1 - 0.32}$

Devise a Plan

Possible plan: To find an expression for CPI in April 2019, and to use the given expression to write and solve an equation.

Step 1: Write an equation to solve.

Step 2: Solve the equation.

Step 3: Simplify.

Solution Steps

- Write an equation to solve. $((1 - 0.32)x = 168.891)$
- Divide both sides by the coefficient. $\left(\frac{(1 - 0.32)x}{1 - 0.32} = \frac{168.891}{1 - 0.32}\right)$
- Simplify. $\left(x = \frac{168.891}{1 - 0.32}\right)$

Career Spotlight: Check

Tips for Completing Exercises 7–12

These tips will help students in solving these exercises and similar assessment items.

Exercise 7

Answer

7. a, d, e, f

Tip Encourage students to write an expression to represent the first sentence of the problem and then compare that expression to the one given in the third sentence. Then they can use the definition of terms to select all true statements.

Exercise 8

Answer

8. Each pair of socks sells for $13.50 and costs $4.82 to make.

Tip Remind students that profit is the revenue and cost. Students should analyze the expression and determine which part represents revenue and which part represents cost. Revenue is the product of the price per item and the number of items sold. The cost is the sum of the fixed and variable costs. The variable cost is the product of the cost per item and the number of items sold.

- The revenue is the product of the price per item and the number of items sold.
- The variable cost is the product of the cost per item and the number of items sold.

Exercise 9

Answer

9. C

Tip Students should match the first factor in the numerator of each expression to the median home price in thousands in the table.

Exercise 10

Answer

10. D

Tip Encourage students to examine the answer choices after reading the problem to find the one that matches the quantity described. The number of working-age adults without a job includes both those who are unemployed and those who are not in the labor force, so the answer must show a sum. This eliminates choices A and B.

Exercise 11

Answer

11. b, c, e

Tip Encourage students to examine the answer choices after reading the problem to eliminate choices that can easily be identified as incorrect. For example, there is a variable with 7.2 and 29 but not with 935, so 935 cannot be a variable cost. This eliminates choice F.

Exercise 12

Answer

12. b. food only, b. January 2020, c. February 2020

Tip Encourage students to first identify the quantities in the table that match the quantities in the expression.

Notes