6.EE.9.1 Task • Expressions and Equations

How Much Should That Specialty Pizza Cost?

Common Core State Standard

Represent and analyze quantitative relationships between dependent and independent variables.

6.EE.9.1. Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable.

Task Overview

Background

This task allows students to think about independent and dependent variables in the real world. Students then represent the relationship between the two variables using an equation. Part 1 guides the students through the procedure for a small pizza, then asks them to write an equation for the medium and large pizzas independently. Part 2 asks students to consider the cost of specialty pizzas in relation to the “create your own” pizzas. Students must then determine if customers who order specialty pizzas are paying more than customers who create their own, and when it is cost effective to order a specialty pizza versus creating their own.

This task also provides practice with:

• writing equations to represent real-world situations
• comparing values
• calculating with decimals/money

Implementation Suggestions

Students can work individually or in groups for this task. This task should follow an introduction or review of independent and dependent variables.

Introduction

Ask students to think about dependent and independent variables in their lives. Have students suggest quantities that are dependent on other quantities. Examples may include cell phone bills and number of texts sent, or the final score of a baseball game and the total number of hits.
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Monitoring/Facilitating the Task
Ask questions and prompt student thinking so that they:

• Notice that the responses for questions 1–7 use only two possible answers: the cost of pizza and the number of toppings.
• Realize that the cost of the pizza changes based on the number of toppings selected, and that this differs from the number of toppings changing based on the cost of the pizza.
• Select the correct variable, \( x \) or \( y \), to represent their quantities.
• Justify their solutions in question 12 using the equations they created.

Debriefing the Task
Have students form small groups to discuss their results. Students should compare their equations, looking for similarities and differences. They should debate any inconsistencies in their solutions, using their equations to justify the answer they believe to be correct. Each group should decide on their group solutions to question 12 and write their answers on the board.

As a class, review the solutions to the worksheet, leaving the information on the board for the final discussion. Topics for discussion include:

• how students determined which quantity was dependent and which was independent
• how students represented the different information in an equation

Answer Key
1. the cost of the pizza and the number of toppings
2. the number of toppings
3. the cost of the pizza
4. cost of the pizza; number of toppings
5. number of toppings; cost of the pizza
6. the number of toppings; \( x \)
7. the cost of the pizza; \( y \)
8. cost of pizza = $6.00 + number of toppings • $0.75
9. \( y = 6 + 0.75x \)
10. \( y = 8 + x \)
11. \( y = 11 + 1.25x \)
12. Students should show evidence of having used their equations to arrive at the following conclusions for each type of pizza:

I Love Meat: It’s cheaper to create your own for all three sizes.

I Love Vegetables: It’s cheaper to order the specialty pizza for all three sizes.

I Love Cheese: It costs the same to create your own small or medium as it would to order the specialty pizza, but the specialty large is cheaper than creating your own.

I Love Simplicity: It’s cheaper to create your own for the small and medium, but not the large.

I Love Everything: It’s cheaper to create your own for the small and medium, but not the large.

Completed table:

<table>
<thead>
<tr>
<th>Specialty pizza: I Love Meat</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialty price</td>
<td>$12.00</td>
<td>$16.25</td>
<td>$19.50</td>
</tr>
<tr>
<td>“Create your own” price</td>
<td>$10.50</td>
<td>$14.00</td>
<td>$18.50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specialty pizza: I Love Vegetables</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialty price</td>
<td>$9.50</td>
<td>$13.75</td>
<td>$17.00</td>
</tr>
<tr>
<td>“Create your own” price</td>
<td>$12.75</td>
<td>$17.00</td>
<td>$22.25</td>
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</table>

<table>
<thead>
<tr>
<th>Specialty pizza: I Love Cheese</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialty price</td>
<td>$8.25</td>
<td>$11.00</td>
<td>$13.25</td>
</tr>
<tr>
<td>“Create your own” price</td>
<td>$8.25</td>
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<td>$14.75</td>
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<table>
<thead>
<tr>
<th>Specialty pizza: I Love Simplicity</th>
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</thead>
<tbody>
<tr>
<td>Specialty price</td>
<td>$7.00</td>
<td>$9.50</td>
<td>$11.50</td>
</tr>
<tr>
<td>“Create your own” price</td>
<td>$6.75</td>
<td>$9.00</td>
<td>$12.25</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Specialty pizza: I Love Everything</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialty price</td>
<td>$15.50</td>
<td>$19.00</td>
<td>$22.75</td>
</tr>
<tr>
<td>“Create your own” price</td>
<td>$13.50</td>
<td>$18.00</td>
<td>$23.50</td>
</tr>
</tbody>
</table>

**Differentiation**

You may consider assigning only one size or type of pizza to specific individuals in place of completing question 12 for all sizes and types. Students may also wish to design their favorite pizza and determine its cost if they created their own pizza with the available toppings.
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Technology Connection
As a next step, to extend this task to the second part of the standard (“analyze the relationship between dependent and independent variables using graphs and tables...”), students can use graphing software to produce graphs and/or spreadsheet software to produce tables using the given information and their answers.

Choices for Students
Students may decide to use the menu from a local pizzeria to create the same comparisons. This information could then be used to create a “Best Pizza Deal at Joe’s Pizza” pamphlet for circulation in the class, school, or community.

Meaningful Context
Independent and dependent variables are seen in many different contexts aside from those used in mathematics. Students can explore independent and dependent variables in a variety of contexts. For example, if global warming is the independent variable, have students compose a list of possible dependent variables that may be related to the independent variable. Have students research quantitative values to represent each variable.

Recommended Resources
- Independent vs. Dependent Variables
  www.walch.com/rr/CCTTG6IndependentVsDependent
  This animated video covers the basics of dependent and independent variables by comparing player performance in a soccer game.
- Internet Pizza Server Ordering Area
  www.walch.com/rr/CCTTG6PizzaEquations
  This site allows you to select traditional as well as unusual/impossible pizza toppings and “order” a pizza. The application then returns your pizza along with the cost of the pizza. Advanced students may enjoy the challenge of trying to figure out the equation used to represent the cost of the pizza.
- One Thing Depends on Another
  www.walch.com/rr/CCTTG6VariableVideo
  This music video spoof of an '80s pop song provides a short review of independent and dependent variables and includes domain, range, and function information.
Part 1

Use what you know about independent and dependent variables along with the following information to answer the questions.

A local pizza shop offers the option of creating your own pizza. Each pizza includes tomato sauce, mozzarella cheese, a thin crust, and additional toppings as requested. A small cheese pizza costs $6.00, and each additional topping is $0.75.

1. What are the two quantities that will change when deciding which pizza to order?
___________________________________________________________________

2. Which quantity represents the independent variable? ________________________

3. Which quantity represents the dependent variable? ________________________

4. The ________________________ is dependent on the ________________________.

5. The ________________________ is independent of the ________________________.

6. The independent quantity, ________________________, is represented with the variable x OR y (circle one).

7. The dependent quantity, ________________________, is represented with the variable x OR y (circle one).

8. Write an equation to represent the cost of a small pizza in terms of the number of toppings ordered.
9. Substitute variables into the equation you wrote for problem 8.

The pizza shop also offers medium and large “create your own pizza” options. The medium pizza costs $8.00 plus $1.00 per topping. The large pizza costs $11.00 plus $1.25 per topping.

10. Use the same variables you chose in problem 9 to write an equation to represent the cost of a medium pizza in terms of the number of toppings ordered.

11. Use the same variables as in problem 9 to write an equation to represent the cost of a large pizza in terms of the number of toppings ordered.
Part 2

The pizza shop also offers the following specialty pizzas. Each pizza includes tomato sauce, mozzarella cheese, a thin crust, and additional toppings as listed.

- **I Love Meat**
  pepperoni, ham, ground beef, bacon, sausage, chicken
  Small: $12.00  Medium: $16.25  Large: $19.50

- **I Love Vegetables**
  green peppers, tomatoes, onions, olives, mushrooms, spinach, jalapenos, broccoli, garlic
  Small: $9.50  Medium: $13.75  Large: $17.00

- **I Love Cheese**
  ricotta cheese, Parmesan cheese, Asiago cheese
  Small: $8.25  Medium: $11.00  Large: $13.25

- **I Love Simplicity**
  pepperoni
  Small: $7.00  Medium: $9.50  Large: $11.50

- **I Love Everything**
  pepperoni, ham, ground beef, bacon, sausage, chicken, green peppers, tomatoes, onions, olives
  Small: $15.50  Medium: $19.00  Large: $22.75

*continued*
12. An ad in the pizza shop says you can “Save by ordering our specialty pizzas!” But since the name of the shop is Cheatza Pizza, you wonder if ordering a specialty pizza actually costs more than creating your own pizza with the same number of toppings. You want to know if customers are being cheated.

Use the equations you created in Part 1 to find out whether it is cheaper to purchase the specialty pizza or to create your own for each specialty pizza combination. Fill in the “create your own” prices for each pizza in the table below. Is it ever cheaper to create your own pizza? Justify your response for each specialty pizza by using your equations.

<table>
<thead>
<tr>
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