

# INDEPENDENT AND DEPENDENT VARIABLES

depends on graph

y

x

proportional

table linear changes

Mar 26-3:50 PM

## Lesson 31: Problems in Mathematical Terms

**Student Outcomes**

- Students analyze an equation in two variables to choose an independent variable and dependent variable. Students determine whether or not the equation is solved for the second variable in terms of the first variable or vice versa. They then use this information to determine which variable is the independent variable and which is the dependent variable.
- Students create a table by placing the independent variable in the first row or column and the dependent variable in the second row or column. They compute entries in the table by choosing arbitrary values for the independent variable (no constraints) and then determine what the dependent variable must be.

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**Classwork**

**Example 1 (10 minutes)**

**Example 1**  
 Marcus reads for 30 minutes each night. He wants to determine the total number of minutes he will read over the course of a month. He wrote the equation  $t = 30d$  to represent the total amount of time that he has spent reading, where  $t$  represents the total number of minutes read and  $d$  represents the number of days that he read during the month. Determine which variable is independent and which is dependent. Then create a table to show how many minutes he has read in the first seven days.

| Number of Days ( $d$ ) | Total Minutes Read ( $t$ ) |
|------------------------|----------------------------|
| 1                      | 30                         |
| 2                      | 60                         |
| 3                      | 90                         |
| 4                      | 120                        |
| 5                      | 150                        |
| 6                      | 180                        |
| 7                      | 210                        |

Independent variable: Number of Days  
 Dependent variable: Total Minutes Read

**MP.1**

- When setting up a table, we want the independent variable in the first column and the dependent variable in the second column.
- What do independent and dependent mean?
  - The independent variable changes, and when it does, it affects the dependent variable. So, the dependent variable "depends" on the independent variable.
- In this example, which would be the independent variable and which would be the dependent variable?
  - The dependent variable is the total number of minutes read because it depends on how many days Marcus reads. The independent variable is the number of days that Marcus reads.
- How could you use the table of values to determine the equation if it had not been given?
  - The number of minutes read shown in the table is always 30 times the number of days. So, the equation would need to show that the total number of minutes is equal to the number of days times 30.

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**Example 2 (5 minutes)**

**Example 2**  
 Kira designs websites. She can create three different websites each week. Kira wants to create an equation that will give her the total number of websites she can design given the number of weeks she works. Determine the independent and dependent variables. Create a table to show the number of websites she can design over the first 5 weeks. Finally, write an equation to represent the number of websites she can design when given any number of weeks.

| # of Weeks Worked ( $w$ ) | # of Websites Designed ( $d$ ) |
|---------------------------|--------------------------------|
| 1                         | 3                              |
| 2                         | 10                             |
| 3                         | 15                             |
| 4                         | 20                             |
| 5                         | 25                             |

Independent variable: # of weeks worked  
 Dependent variable: # of websites designed

Equation:  $d = 5w$ , where  $w$  is the number of weeks worked and  $d$  is the number of websites designed.

**MP.1**

- How did you determine which is the dependent variable and which is the independent variable?
  - Because the number of websites she can make depends on how many weeks she works, I determined that the number of weeks was the independent variable and the number of websites designed was the dependent variable.
- Does knowing which one is independent and which one is dependent help you write the equation?
  - I can write the equation and solve for the dependent variable by knowing how the independent variable will affect the dependent variable. In this case, I knew that every week 5 more websites could be completed, so then I multiplied the number of weeks by 5.

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**Example 3 (5 minutes)**

**Example 3**  
 Priya streams movies through a company that charges her a \$5 monthly fee plus \$1.50 per movie. Determine the independent and dependent variables, write an equation to model the situation, and create a table to show the total cost per month given that she might stream between 4 and 10 movies in a month.

| # of Movies ( $m$ ) | Total Cost Per Month ( $c$ ) |
|---------------------|------------------------------|
| 4                   | 11                           |
| 5                   | 12.50                        |
| 6                   | 14                           |
| 7                   | 15.50                        |
| 8                   | 17                           |
| 9                   | 18.50                        |
| 10                  | 20                           |

Independent variable: # of movies watched per month  
 Dependent variable: Total cost per month  
 Equation:  $c = 1.5m + 5$  or  $c = 1.50m + 5$

**MP.1**

- Is the flat fee an independent variable, a dependent variable, or neither?
  - The \$5 flat fee is neither. It is not causing the change in the dependent value, and it is not changing. Instead, the \$5 flat fee is a constant that is added on each month.
- Why isn't the equation  $c = 5m + 1.50$ ?
  - The \$5 fee is only paid once a month.  $m$  is the number of movies watched per month, so it needs to be multiplied by the price per movie, which is \$1.50.

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**Classwork**

**Example 1**  
 Marcus reads for 30 minutes each night. He wants to determine the total number of minutes he will read over the course of a month. He wrote the equation  $t = 30d$  to represent the total amount of time that he has spent reading, where  $t$  represents the total number of minutes read and  $d$  represents the number of days that he read during the month. Determine which variable is independent and which is dependent. Then create a table to show how many minutes he has read in the first seven days.

| Number of Days ( $d$ ) | Total Minutes Read ( $t$ ) |
|------------------------|----------------------------|
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Independent variable: \_\_\_\_\_  
 Dependent variable: \_\_\_\_\_

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**Example 2**

Kira designs websites. She can create three different websites each week. Kira wants to create an equation that will give her the total number of websites she can design given the number of weeks she works. Determine the independent and dependent variables. Create a table to show the number of websites she can design over the first 5 weeks. Finally, write an equation to represent the number of websites she can design when given any number of weeks.

Independent variable \_\_\_\_\_

Dependent variable \_\_\_\_\_

Equation \_\_\_\_\_

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**Example 3**

Prize streams movies through a company that charges her a \$5 monthly fee plus \$1.50 per movie. Determine the independent and dependent variables, write an equation to model the situation and create a table to show the total cost per month given that she might stream between 4 and 10 movies in a month.

Independent variable \_\_\_\_\_

Dependent variable \_\_\_\_\_

Equation \_\_\_\_\_

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**Exercises**

1. Sarah is purchasing pencils to share. Each package has 12 pencils. The equation  $n = 12p$ , where  $n$  is the number of pencils and  $p$  is the number of packages can be used to determine the total number of pencils Sarah purchased. Determine which variable is dependent and which is independent. Then make a table showing the number of pencils purchased for 3-7 packages.

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2. Charlotte reads 4 books each week. Let  $b$  be the number of books she reads each week and let  $w$  be the number of weeks that she reads. Determine which variable is dependent and which is independent. Then write an equation to model the situation, and make a graph that shows the number of books read in under 6 weeks.

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3. A miniature golf course has a special group rate. You can pay \$20 plus \$3 per person when you have a group of 5 or more friends. Let  $f$  be the number of friends and  $c$  be the total cost. Determine which variable is independent and which is dependent, and write an equation that models the situation. Then make a table to show the cost for 5 to 12 friends.

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4. Carlos is shopping for school supplies. He bought a pencil box for \$3 and he also needs to buy notebooks. Each notebook is \$2. Let  $t$  = the total cost of the supplies and  $n$  be the number of notebooks. Determine which variable is independent and which is dependent, and write an equation that models the situation. Then make a table to show the cost for 1 to 5 notebooks.

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**Problem Set**

1. Jaziyah sells 3 houses each month. To determine the number of houses she can sell in any given number of months she uses the equation  $t = 3m$ , where  $t$  is the total number of houses sold and  $m$  is the number of months. Name the independent and dependent variables. Then create a table to show how many houses she sells in less than 6 months.

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2. Joshua spends 25 minutes of each day reading. Let  $d$  be the number of days that he reads and let  $m$  represent the total minutes of reading. Determine which variable is independent and which is dependent. Then write an equation that will model the situation. Make a table showing the number of minutes spent reading over 7 days.

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3. Each package of hot dog buns contains 8 buns. Let  $p$  be the number of packages and  $b$  be the total number of buns. Determine which variable is independent and which is dependent. Then write an equation that will model the situation and make a table showing the number of hot dog buns in 3 to 8 packages.

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4. Emma was given 5 sea shells. Each week she collected 3 more. Let  $w$  be the number of weeks and  $s$  be the number of sea shells she has total. Which variable is independent and which is dependent? Write an equation to model the relationship, and make a table to show how many shells she has from week 0 to week 10.

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5. Emilia is shopping for fresh produce at a farmer's market. She bought a watermelon for \$5 and she also wants to buy peppers. Each pepper is \$0.75. Let  $t$  = the total cost of the produce and  $n$  be the number of peppers bought. Determine which variable is independent and which is dependent, and write an equation that models the situation. Then make a table to show the cost for 1 to 5 peppers.

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**Classwork**

**Opening Exercise**

An 18-ounce beverage for 1.25, which are individually packaged and come in packs of 8. Let  $p$  be the number of packages Kim buys and  $b$  be the total number of beverages. The equation  $t = 8p$  can be used to calculate the total number of beverages when the number of packages is known. Determine the independent and dependent variable in this scenario. Then make a table using whole number values of  $p$  from 0 to 5.

| Number of Packages ( $p$ ) | Total Number of Beverages ( $t = 8p$ ) |
|----------------------------|--|
| 0                          |  |
| 1                          |  |
| 2                          |  |
| 3                          |  |
| 4                          |  |
| 5                          |  |

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**Example 1**

Make a graph for the table in the Opening Exercise.

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**Example 2**

Use the graph to determine which variable is the independent variable and which is the dependent variable. Then state the relationship between the quantities represented by the variables.

| Hours | Miles |
|-------|-------|
| 1     | 50    |
| 2     | 100   |
| 3     | 150   |
| 4     | 200   |
| 5     | 250   |

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**Exercises**

1. Each week Quentin earns \$10. If he saves this money, create a graph that shows the total amount of money Quentin has saved from week 1 through week 8. Write an equation that represents the relationship between the number of weeks that Quentin has saved his money ( $w$ ) and the total amount of money he has saved ( $s$ ). Then name the independent and dependent variable. Write a sentence that shows this relationship.

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2. Zoe is collecting books to donate. She started with 3 and collects two more each week. She is using the equation  $b = 2w + 3$ , where  $b$  is the total number of books collected and  $w$  is the number of weeks she has been collecting. Name the independent and dependent variables. Then create a graph to represent how many books Zoe has collected when  $w$  is 5 or less.

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3. Eliana plans to visit the fair. She must pay \$5 to enter the fair grounds and an additional \$3 per ride. Write an equation to show the relationship between  $r$ , the number of rides, and  $f$ , the total cost. State which variable is dependent and which is independent. Then create a graph that models the equation.

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**Problem Set**

1. Caleb started saving money in a cookie jar. He started with \$15. He adds \$1.0 to the account each week. Write an equation where  $w$  is the number of weeks and  $d$  is the total amount in the account. Determine which variable is independent and which is dependent. Then graph the total amount in the account for  $w$  being less than 6 weeks.

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2. Ewan is taking a taxi from the airport to his home. There is a \$5 flat fee for riding in the taxi. In addition, Ewan must also pay \$1 per mile. Write an equation where  $m$  is the number of miles and  $t$  is the total cost of the taxi ride. Determine which variable is independent and which is dependent. Then graph the total cost for  $m$  being less than 6 miles.

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3. Anna started with \$10. She saved an additional \$5 each week. Write an equation that can be used to determine the total amount saved,  $t$ , after a given number of weeks,  $w$ . Determine which variable is independent and which is dependent. Then graph the total amount saved for first 8 weeks.

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4. Aliyah is purchasing produce at the farmer's market. She plans to buy \$10 worth of potatoes and some apples. The apples cost \$1.50 per pound. Write an equation to show the total cost of the produce, where  $T$  is the total cost and  $a$  is the number of pounds of apples. Determine which variable is dependent and independent. Then graph the equation on the coordinate plane.

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