

# Road Trip: Applying Systems of Linear Equations

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- Strand:** Equations and Inequalities
- Topic:** Writing equations to describe real-life data; creating statistical plots
- Primary SOL:** A.4 The student will solve
- d) systems of two linear equations in two variables algebraically and graphically; and
  - e) practical problems involving equations and systems of equations.
- Related SOL:** A.7f

## Materials

- Graphing utilities
- Road Trip activity sheet (attached)
- Saving Money activity sheet (attached)
- Salaries activity sheet (attached)

## Vocabulary

*dependent variable, independent variable* (earlier grades)

*linear equation, system of linear equations* (A.4)

## Student/Teacher Actions: What should students be doing? What should teachers be doing?

1. Consider the following example before the activity: Johnny and Matthew go kayaking at the lake. There are two kayak rental locations that Johnny and Matthew can choose from. The first, Krazy Kayaks, charges \$12.00 for the required life jacket rental and \$11.00 per hour of rental. The second, Kayak Adventures, charges \$8.00 for the required life jacket rental and \$12.00 per hour of rental. Which Kayak rental should Johnny and Matthew use?

- Step 1 – create an equation to represent each kayak rental location.
  - Krazy Kayaks:  $y = 11x + 12$
  - Kayak Adventure:  $y = 12x + 8$
- Step 2 – Identify your variables
  - $x$  = number of hours
  - $y$  = total cost
- Step 3 – Select a method to solve the system of linear equations. For this example, we will use substitution.

$$\begin{array}{r} 11x + 12 = 12x + 8 \\ -12x \quad -12x \\ \hline -1x + 12 = 8 \\ \quad -12 \quad -12 \\ \hline -1x = -4 \\ -1 \quad -1 \end{array}$$

$x = 4 \rightarrow$  to solve for  $y$ , we must substitute 4 in for  $x$  in one of the equations. For this example, we will substitute  $x$  into Krazy Kayaks' equations.

$$y = 11x + 12$$

$$y = 11(4) + 12$$

$$y = 56$$

Final Answer: (4, 56)

When you want to spend four hours renting a kayak, the location you choose does not matter because they will both cost \$56.

Follow-up questions to ask students?

- When should you rent kayaks from Krazy Kayaks?
  - When should you rent kayaks from Kayak Adventure?
  - When does it financially not matter which kayak rental location you choose to rent from?
2. Distribute the Road Trip activity sheet. Have students investigate the problem and the cost for Prestige Auto by working in pairs to complete the Prestige Auto chart, concentrating on the independent and dependent variables. Have students write an equation that represents this data.
  3. Then, have students complete the same procedure for Getaway Auto, entering the data in the Getaway Auto chart and writing an equation to represent this data.
  4. Have students fill in the data in the third chart and then answer the questions comparing the data and the range of values to determine when it makes sense to use one or the other auto rental company.

### Assessment

- **Questions**
  - Write a system of equations that has (2, -3) as the solution.
  - Write a system of equations that has no solution.
- **Journal/Writing Prompts**
  - Write about a real-world situation that can be solved using systems of equations.
- **Other**
  - Distribute the Salaries activity sheet, and have students follow the same procedures to complete the problem.

### Extensions and Connections (for all students)

- Distribute Saving Money activity sheet, and have students follow the same procedures to complete the problem.

### Strategies for Differentiation

- Encourage the use of graph paper, graphing utilities, pictorial representations of the problems, and graphic organizers to represent the information.
- Have students use highlighters to highlight important information in word problems.

- Some students may need to do the first problem collaboratively in a small group and then do the rest in pairs. Other students may need to do the first few rows of the first problem collaboratively and then do the rest in pairs.
- Have students write the equation for each car rental company at the top of the columns in the chart.
- Allow students to choose which method they will use to solve each system of linear equations.

**Note: The following pages are intended for classroom use for students as a visual aid to learning.**

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## Road Trip



Name \_\_\_\_\_ Date \_\_\_\_\_

You are planning a one-day road trip, but you don't have a car. You have investigated rental cars available from companies in the area and have decided to rent a car from either Prestige Auto or Getaway Auto.

1. Prestige Auto charges \$35 a day plus 24¢ per mile. Fill in data in the chart below to indicate the charges you would incur for rental from Prestige Auto.

Miles Driven	Start-up Cost	Cost for Miles Driven	Total Cost of Trip
0			
20			
40			
60			
80			
100			
120			
140			
160			

- Which values change in this situation? \_\_\_\_\_
- What causes the values to change? \_\_\_\_\_
- What is the *independent* variable? (causes the change) \_\_\_\_\_
- What is the *dependent* variable? (is affected by the change) \_\_\_\_\_
- Write an equation in words to explain the situation. \_\_\_\_\_  
\_\_\_\_\_
- Write an equation in algebraic notation to explain this situation. \_\_\_\_\_

2. Getaway Auto charges \$51 a day plus 16¢ per mile. Fill in data in the chart below to indicate the charges you would incur for rental from Getaway Auto.

Miles Driven	Start-up Cost	Cost for Miles Driven	Total Cost of Trip
0			
20			
40			
60			
80			
100			
120			
140			
160			

- Which values change in this situation? \_\_\_\_\_
- What causes the values to change? \_\_\_\_\_
- What is the *independent* variable? (causes the change) \_\_\_\_\_
- What is the *dependent* variable? (is affected by the change) \_\_\_\_\_
- Write an equation in words to explain the situation. \_\_\_\_\_  
\_\_\_\_\_
- Write an equation in algebraic notation to explain this situation. \_\_\_\_\_

3. Complete the table below, using the equations you developed in number 1 and 2.

Miles Driven	Cost of Car from Prestige Auto	Cost of Car from Getaway Auto
50		
75		
100		
200		
250		
300		
325		

- Is there a particular number of miles driven at which the cost of using Prestige is the same as using Getaway? \_\_\_\_\_ If so, what is it? \_\_\_\_\_
- Is there a range of values of miles driven in which the cost of using Prestige is less than using Getaway? \_\_\_\_\_ If so, what is it? \_\_\_\_\_
- When is it cheaper to use Getaway? \_\_\_\_\_

### Saving Money



Name \_\_\_\_\_

Date \_\_\_\_\_

Nilda has \$480 dollars in her sock drawer. She plans to save \$30 per week from now on.

1. Complete the chart to show the amount of money Nilda has in her sock drawer.

No. of Weeks	Beginning Amount	Amount Added	Total Amount
0			
1			
2			
3			
4			
5			
6			

- Which values change in this situation? \_\_\_\_\_
- What causes the values to change? \_\_\_\_\_
- What is the *independent* variable? (causes the change) \_\_\_\_\_
- What is the *dependent* variable? (is affected by the change) \_\_\_\_\_
- Write an equation in words to explain the situation. \_\_\_\_\_  
\_\_\_\_\_
- Write an equation in algebraic notation to explain this situation. \_\_\_\_\_
- At this rate, after how many weeks will Nilda have \$690 in her sock drawer? \_\_\_\_\_
- After how many weeks will she have \$2,040 in her sock drawer? \_\_\_\_\_
- If Nilda’s mom had put money in Nilda’s sock drawer at the same rate each week, how long had Nilda’s mom been saving before Nilda took over? \_\_\_\_\_
- Graph your equation using your graphing calculator. Do your answers match the graph?  
\_\_\_\_\_ Do your answers match the table? \_\_\_\_\_

### Salaries

Name \_\_\_\_\_ Date \_\_\_\_\_



Manny just graduated from high school and has been offered a job. He will start at \$18,000 per year with a promise of a \$500 raise per year. Sonny just graduated from college and has been offered a job. He has been offered \$24,000 per year with a promise of a \$300 raise per year.

1. Complete the following chart.

Manny		Sonny	
Years' Experience	Salary	Years' Experience	Salary
0		0	
1		1	
2		2	
3		3	
4		4	
5		5	

1. What is the *independent* variable? \_\_\_\_\_
2. What is the *dependent* variable? \_\_\_\_\_
3. What is the equation for each graph? \_\_\_\_\_
4. Graph the equations on the same screen. Does Manny ever make more money than Sonny? \_\_\_\_\_ If so, when? \_\_\_\_\_ How do you know? \_\_\_\_\_  
\_\_\_\_\_
5. At which point will Manny and Sonny earn the same amount of money? Show your solution algebraically.