7.4 Basketball Tournament

Using Linear Combinations to Solve a Linear System

Objective

In this lesson, you will:

- Solve a linear system by using linear combinations.

Key Terms

- standard form of a linear equation
- linear combinations method
- linear combination

SCENARIO Your school hosted a basketball tournament. Tickets were sold before the tournament and at the door. More tickets were bought before the tournament than were bought at the door. In fact, there was a difference of 84 tickets between the two kinds of tickets sold. A total of 628 tickets were sold.

Problem 1 Ticket Sales

A. Write an equation in standard form that represents the total number of tickets sold. Use x to represent the number of tickets sold before the tournament and use y to represent the number of tickets sold at the door.

B. Write an equation in standard form that represents the difference in the numbers of tickets sold.

C. How are these equations different? How are they the same? Use complete sentences in your answer.

Investigate Problem 1

1. Write the linear system for this problem situation below.

Now, add the equations together.

Solve the resulting equation. Use a complete sentence in your answer.

Investigate Problem 1

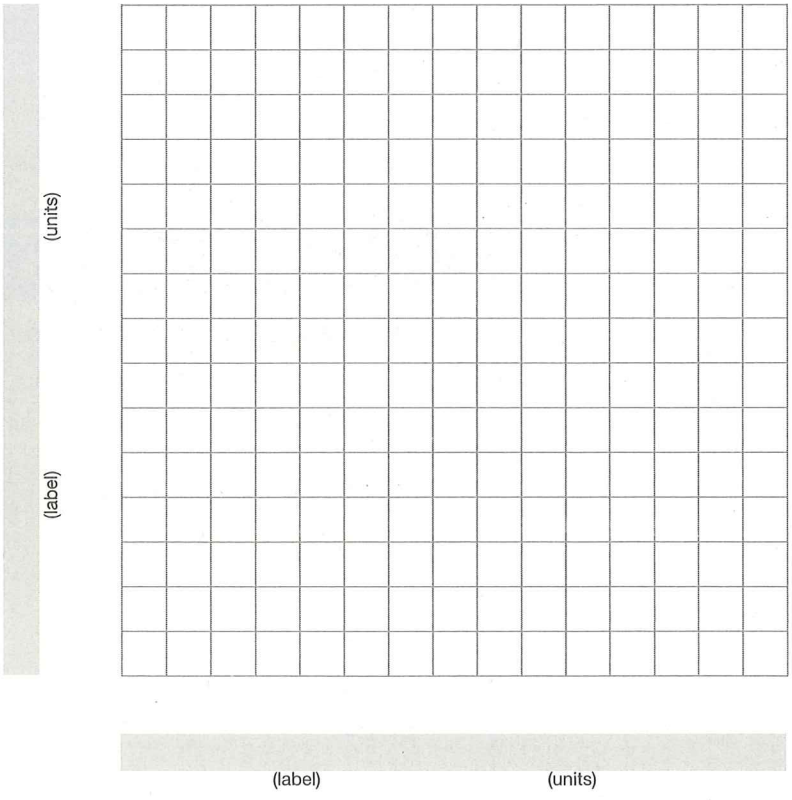
Now find the value for y by substituting your value for x into one of the original equations.

What is the solution of your linear system? Use a complete sentence in your answer.

2. Check your solution algebraically.

3. Check your solution by creating a graph of your linear system on the grid below. First, choose your bounds and intervals. Be sure to label your graph clearly.

Variable quantity	Lower bound	Upper bound	Interval



Investigate Problem 1

4. Interpret the solution of the linear system in the problem situation. Use a complete sentence in your answer.

5. What effect did adding the equations together have? Use complete sentences in your answer.

6. Describe how the coefficients of y in the original system are related. Use a complete sentence in your answer.

Problem 2 Traveling to the Tournament

A team that entered the tournament sold popcorn and mixed nuts to raise enough money to travel to the tournament. They made \$1.50 from each tin of popcorn and \$2 from each tin of mixed nuts. They raised a total of \$655 and sold 390 tins.

A. Write an equation in standard form that represents the total amount of money raised. Use x to represent the number of tins of popcorn sold and use y to represent the number of tins of nuts sold.

B. Write an equation in standard form that represents the total number of tins sold.

C. How are these equations different? How are they the same? Use complete sentences in your answer.

Investigate Problem 2

1. Multiply each side of the equation that represents the total number of tins sold by –2. Show your work.

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Take Note

When a variable is multiplied by a number, the number is called the **coefficient.**

Investigate Problem 2

2. Write a linear system from the equation in part (A) and the equation in Question 1.

3. How do the coefficients of the equations in your linear system compare? Use complete sentences in your answer.

4. Add the equations in your linear system together. Then simplify the result. Show your work.

5. What does the result in Question 4 represent? Use a complete sentence in your answer.

6. Find the value for y by substituting your value for x into the original equation from part (B). Show your work.

7. What is the solution of the linear system? Interpret the solution of the linear system in the problem situation. Use complete sentences in your answer.

8. Check your solution algebraically. Show all your work.

9. **Just the Math: Linear Combinations Method**
The method you used to solve the linear systems in Problems 1 and 2 is called the **linear combinations method.** A **linear combination** is an equation that is the result of adding two equations to each other. The goal of adding the equations together is to get an equation in one variable. Then you can find the value of one variable and use it to find the value of the other variable.

Investigate Problem 2

In many cases, one (or both) of the equations in the system must be multiplied by a constant so that when the equations are added together, the result is an equation in one variable. For instance, consider the system

$4x + 2y = 3$
$5x - 3y = 1.$

What is the least common multiple of 2 and 3?

What do you have to multiply 2 by to get 6? What do you have to multiply 3 by to get 6?

So, multiply the first equation by 3 and multiply the second equation by 2. Complete the steps below.

$3(4x + 2y) = 3(3)$ ⇨ $\square x + \square y = \square$

$2(5x - 3y) = 2(1)$ ⇨ $\square x - \square y = \square$

Now, solve the new linear system. Show all your work and use a complete sentence in your answer.

10. For each linear system below, describe the first step you would take to solve the system by using the linear combinations method. Identify the variable that will be solved for when you add equations. Use complete sentences in your answer.

$4x - 3y = 8$ and $2x - 3y = 1$

$3x + 4y = 2$ and $2x - y = 4$

$6x + 5y = 1$ and $3x + 4y = 2$

$8x + 3y = 2$ and $-7x + 4y = 5$

Investigate Problem 2

11. Solve each linear system using linear combinations. Show all your work.

$$-5x + 2y = -10$$
$$3x - 6y = -18$$

$$7x - 4y = -3$$
$$2x + 5y = -7$$

12. Describe the kinds of linear systems for which you would use the substitution method you learned in the last lesson to solve the system. Describe the kinds of linear systems for which you would use the linear combinations method to solve the system. Use complete sentences in your answer.