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Applications of Linear Systems

Unit 6 Lesson 4

Students will be able to:

Recognize and solve the different applications of linear systems of equations like relationship between numbers, mixtures, business, investment and geometry.

Key Vocabulary:

- Solving Linear Systems using Elimination
- Solving Linear Systems using Substitution
- Linear Equations in two variables

APPLICATIONS OF LINEAR SYSTEMS

LINEAR SYSTEM OF EQUATIONS

Is a set of equations with the same pair of variables.

APPLICATIONS OF LINEAR SYSTEM OF EQUATIONS

Are represented through story problems or word problems. The point is to set up the equations and solve the system.

These applications mostly represent the following topics:

- Relation between numbers
- Mixtures
- Business
- Geometry
- Investment

STEPS TO SOLVE WORD PROBLEMS OF LINEAR SYSTEMS

- **Step 1:** Read the problem carefully to determine the unknown quantities.
- **Step 2:** Choose a variable to represent the unknown terms.
- **Step 3:** Translate the problem to the language of algebra to set up the system of equations.
- **Step 4:** Solve the system of equations and answer the question of the original problem.
- **Step 5:** Verify your solution by replacing the results in the original equation and proving the equality.

APPLICATIONS OF LINEAR SYSTEMS

Sample Problem 1 (Relation between numbers)

The sum of two numbers is 18 and their difference is 6. Find the numbers.

Identify variables

x: First unknown number y: Second unknown number

Set up equations

$$\boldsymbol{x + y = 18 \qquad and \qquad x - y = 6}$$

Solve linear System

In this case we will use the elimination method, like follows:

$$\begin{cases} x + y = 18 \\ x - y = 6 \end{cases}$$

The result would be:

$$2x = 24 \qquad \rightarrow \qquad x = \frac{24}{2} = 12$$

Now, we calculate the value of variable "y" by substituting the result of "x" into one of the equations

$$y = 18 - x = 18 - 12 \qquad \rightarrow \qquad y = 6$$

The numbers are 12 and 6

APPLICATIONS OF LINEAR SYSTEMS

Sample Problem 2 (Mixtures)

A student needs to prepare a solution combining a 30% alcohol solution with a 50% alcohol solution to form 300 ml of a 40% final solution. How much of each solution should be used to form the mixture?

Identify variables

x: Alcohol solution at 30%   y: Alcohol solution at 50%

Set up equations

$$\boldsymbol{x+y=300} \qquad \boldsymbol{and} \qquad \boldsymbol{0.30x+0.50y=0.40(300)}$$

Solve linear System

We will use the elimination method, like follows:

$$\begin{cases} x+y=300 \\ 0.30x+0.50y=120 \end{cases}$$

We interchange the "x" or "y" coefficients from equation I and equation II to eliminate one of the variables. In this case, we are going to interchange the "x" coefficients of both equations, like follows:

$$\begin{cases} 0.30(x+y=300) \\ -1\ (0.30x+0.50y=120) \end{cases}$$

Applying distributive property: $\begin{cases} 0.30x+0.30y=90 \\ -0.30x-0.50y=-120 \end{cases}$

The result would be:

$$-0.20y=-30 \qquad \to y=150\ ml$$

Now, we calculate the value of variable "x" by substituting the result of "y" into one of the equations

$$x=300-y=300-150=150\ ml$$

It should be used 150 ml of solution at 30% and 150 ml of solution at 50%

APPLICATIONS OF LINEAR SYSTEMS

Sample Problem 3 (Investment)

A total of \$5500 was invested in two accounts. Part was invested in a CD at 2% annual interest rate and part was invested in a money market fund at 1% annual interest rate. If the total simple interest for one year was \$100, then how much was invested in each account?

<u>Identify variables</u>

x: Amount invested at 2%   y: Amount invested at 1%

<u>Set up equations</u>

$$\boldsymbol{x + y = 5500 \qquad and \qquad 0.02x + 0.01y = 100}$$

<u>Solve linear System</u>

We will use the elimination method, like follows:

$$\begin{cases} x + y = 5500 \\ 0.02x + 0.01y = 100 \end{cases}$$

We interchange the "x" or "y" coefficients from <u>equation I</u> and <u>equation II</u> to eliminate one of the variables. In this case, we are going to interchange the "x" coefficients of both equations, like follows:

$$\begin{cases} 0.02(x + y = 5500) \\ -1(0.02x + 0.01y = 100) \end{cases}$$

Applying distributive property: $\begin{cases} 0.02x + 0.02 = 110 \\ -0.02x - 0.01y = -100 \end{cases}$

The result would be:

$$0.01y = 10 \qquad \rightarrow y = 1000$$

Now, we calculate the value of variable "x" by substituting the result of "y" into one of the equations

$$x = 5500 - y = 5500 - 1000 = 4500$$

It was invested \$4500 in the account at 2% and \$1000 in the account of 1%.