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Different Methods of Solving the System of Equations

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Abstract: In this article, methods for solving systems of two equations with two unknowns of the first order and three equations of the first order with three unknowns are presented. It is explained that both systems of equations are solved by addition and substitution methods. The examples and formulas given in the article will help you improve your understanding and solve the system of equations. Both methods of solving the system of equations are shown more clearly through problems and examples.
Key words: Equality, equation, system of equations in two unknowns, normal form, literal coefficients, method of substitution, method of addition, system of equations in three unknowns.

INTRODUCTION

The connection of two expressions with the sign of equality is called equality. A short expression of equality can be written in the form of a=b.

If both parts of an equation consisting of one or more letters do not have the same numerical value at any numerical value of these letters, such an equation is called an equation. Numbers marked with these letters are called unknown numbers of the equation.

1. System of two equations with two unknowns of the first degree

Description. The connection of unknown numbers x, y with two 1st degree equations is called a 1st degree system of two equations with two unknowns. The general view of such an equation $\begin{cases} ax + by = c_1 \\ a_1x + b_1x = c_1 \end{cases}$ (1)

You can write in the form.

(1) The system in the form is called the normal form of the system of two equations with two unknowns of the first degree. Here: x and y are unknown numbers, a; b; c; a_1; b_1; c_1's are called given numbers or literal coefficients.

Solutions:

Adding method. $\begin{cases} ax + by = c \\ a_1x + b_1y = c_1 \end{cases}$

be given. In the addition method, one of the unknowns x and y must be lost, for example, y. To do this, multiply the first equation of (1) by b_1, and the second equation by -b, then add the second equation to the first equation:+ $\begin{cases} ab_1x + bb_1y = cb_1 \\ -a_1bx - bb_1y = -c_1b \end{cases} \Rightarrow (ab_1 - a_1b)x = cb_1 - c_1b$

from this: $x = \frac{cb_1 - c_1b}{ab_1 - a_1b}$. Now we find y by putting this value of x into one of the equations, for example, if we put it in equation 1 and simplify it, $y = \frac{ac_1 - a_1c}{ab_1 - a_1b}$ is formed. This is the denominator of the derived x, y formulas $ab_1 - a_1b \neq 0$ must be [1-7].

An example.

$$\begin{cases} 5x - 2y = 1 \\ 3x + 4y = 24 \end{cases}$$

Let it be solved by adding the system.

Solving. We multiply the first equation by 2, the second equation by 1, and multiply the result; we write what is said like this:

$$+\begin{cases} 5x - 2y = 1 \mid \cdot 2 \\ 3x + 4y = 24 \mid \cdot 1 \end{cases} \Longrightarrow 13x + 0 = 26$$

From this: $x = \frac{26}{13} = 2.$ Now we find y, $5 \cdot 2 - 2y = 1$ or $2y = 9$, From this: $y = \frac{9}{2} = 4{,}5$.

Substitution method.

This

$$\begin{cases} ax + by = c \\ a_1x + b_1x = c_1 \end{cases}$$

let the system be given.

In this method, we express one unknown from one of the equations, for example, from the first one, for example, y, with the second unknown x, put it in the second equation, and solve the resulting equation of the first degree with one unknown. That is $ax + by = c$ from the equation: $y = \frac{c - ax}{b}$, simplifying this into the second equation:

$a_1x + b_1 \cdot \frac{c - ax}{b} = c_1$ or $(a_1b - ab_1)x = bc_1 - b_1c$,

$(ab_1 - a_1b)x = cb_1 - c_1b$ will be. We find x from the next equation, $x = \frac{cb_1 - c_1b}{ab_1 - a_1b}$, If we substitute the value of x:

$$y = \frac{c - a \cdot \dfrac{cb_1 - c_1b}{ab_1 - a_1b}}{b} = \frac{ac_1 - a_1c}{ab_1 - a_1b}, \quad (ab_1 - a_1b \neq 0).$$

An example.

$$\begin{cases} 3x + 2y = 5 \\ 13x - 11y = 2 \end{cases}$$

Solve the system by substitution method.

Solving. $3x+2y=5$ from Eq: $y=\frac{5-3x}{2}$; We put this value of y in the second equation: $13x-11\cdot\frac{5-3x}{2}=2$ or $26x-55+33x=4$ or $59x=59$, from this: $x=1$; so, $y=\frac{5-3\cdot1}{2}=1$.

(Answer. x=y=1.)

2. A system of three equations of the first degree with three unknowns

The overview of such a system can be written as follows:

$$\begin{cases} ax+by+cz=d \\ a_1x+b_1y+c_1z=d_1 \\ a_2x+b_2y+c_2z=d_2 \end{cases} \quad (2)$$

In this, x,y,z are unknown numbers, a, b, c, a_1, b_1, c_1, a_2, b_2, c_2, d, d_1, d_2 are known numbers (coefficients).

(2) is called the normal representation of the system of three equations of the first degree with three unknowns. (2) system can also be solved by addition and substitution methods.

Adding method. First, we eliminate one unknown, for example z, and reduce it to a system of two equations with two unknowns:

$$+\begin{cases} ax+by+cz=d \mid \cdot c_1 \\ a_1x+b_1y+c_1z=d_1 \mid \cdot(-c) \end{cases} \Rightarrow (ac_1-a_1c)x+(bc_1-cb_1)y=dc_1-d_1c;$$

$$+\begin{cases} ax+by+cz=d \mid \cdot c_2 \\ a_2x+b_2y+c_2z=d_2 \mid(-c) \end{cases} \Rightarrow (ac_2-a_2c)x+(bc_2-b_2c)y=dc_2-d_2c;$$

$$\begin{cases} (ac_1-a_1c)x+(bc_1-cb_1)y=dc_1-d_1c \\ (ac_2-a_2c)x+(bc_2-b_2c)y=dc_2-d_2c. \end{cases}$$

This system of two equations with two unknowns is solved in the ways described above. If the found values of x, y are put into one of the given equations, z is found from it.

An example. $\begin{cases} 2x+y+3z=1 \\ 4x+3y+z=-9 \\ -x+4y-z=-4 \end{cases}$

Let it be solved by adding the system.

Solving. Considerations for the solution are given to the reader.

$$+\begin{cases} 2x+y+3z=1 \mid \cdot 1 \\ 4x+3y+z=-9 \mid \cdot(-3) \end{cases} \Rightarrow -10x-8y=28;$$

$$+\begin{cases} 4x+3y+z=-9 \\ -x+4y-z=-4 \end{cases} \Rightarrow 3x+7y=-13;$$

$$+\begin{cases} -10x-8y=28 \mid \cdot 3 \\ 3x+7y=-13 \mid \cdot 10 \end{cases} \Rightarrow 46y=-46$$

$$y = -\frac{46}{46} = -1;\ \ x = \frac{-13-7y}{3} = \frac{-13+7}{3} = -2$$

Now we find z by putting the values of x and y into one of the given equations:

$$z = 4y - x + 4 = 4\cdot(-1) - (-2) + 4 = 2$$

$$x = -2;\ \ y = -1;\ \ z = 2.$$

How to put it on. (2) in the system, e.g. $ax + by + cz = d$ finding z from the equation and simplifying it by putting it in the second and third equations, a system of two equations with two unknowns is formed [8-18].

$$z = \frac{d - ax - by}{c};$$

$$\begin{cases} a_1x + b_1y + c_1\cdot\frac{d-ax-by}{c} = d_1 \\ a_2x + b_2y + c_2\cdot\frac{d-ax-by}{c} = d_2 \end{cases}$$

or

$$\begin{cases} \left(a_1 - \frac{ac_1}{c}\right)x + \left(b_1 - \frac{bc_1}{c}\right)y = d_1 - \frac{dc_1}{c} \\ \left(a_2 - \frac{ac_2}{c}\right)x + \left(b_2 - \frac{bc_2}{c}\right)y = d_2 - \frac{dc_2}{c} \end{cases}$$

The resulting system of two equations with two unknowns is solved by the known methods described above.
An example. This

$$\begin{cases} 15x - 4y + z = 1 \\ 4x + 3y + 2z = 9 \\ -5x + 4y - 3z = 13 \end{cases}$$

solve the system of equations by substitution method.

Solving. $15x - 4y + z = 1$ from Eq, $z = 1 - 15x + 4y$ we find and put into the remaining equations:

$$\begin{cases} 4x = 3y + 2 - 30x + 8y - 9 = 0 \\ -5x + 4y - 3 + 45x - 12y - 13 = 0 \end{cases}$$

or

$$+\begin{cases} -26x + 11y = 7\ |\cdot 8 \\ 40x - 8y = 26\ |\cdot 11 \end{cases} \Rightarrow 232x + 0 = 232$$

from this: $x = 1$. In this case: $y = 3;\ z = -2$.

(Answer. $x = 1;\ y = 3;\ z = -2$.)

A system of three equations with three unknowns is usually solved by the addition method.

Examples to reinforce the topic:

1) $$\begin{cases} 7x - 3y + 5z = 1 \\ -2x + y - z = -2 \\ x + 5y - 3z = 4 \end{cases}$$

(Answer . $x = 1{,}9; y = -1{,}65; z = -3{,}45.$)

2) $$\begin{cases} \frac{x}{2}+\frac{3y}{4}+\frac{5z}{3}=45 \\ 5{,}1x+\frac{6}{5}y-4z=15 \\ 0{,}1x-0{,}4y+\frac{4}{5}z=5 \end{cases}$$

(Answer .x=10; y=20; z=15.)

3) $$\begin{cases} \frac{1}{x}+\frac{1}{y}-\frac{6}{z}=9 \\ \frac{1}{x}-\frac{1}{y}-\frac{4}{z}=-5 \\ \frac{1}{z}-\frac{3}{x}+\frac{2}{y}=-4 \end{cases}$$

(Answer . $x=\frac{1}{7}; y=\frac{1}{8}; z=1.)$

4) $$\begin{cases} 0{,}4x+0{,}3y-0{,}2z=4 \\ 0{,}6x-0{,}5y+0{,}3z=5 \\ 0{,}3x+0{,}2y+0{,}5z=22 \end{cases}$$

(Answer . $x=10; y=20; z=30.)$

5) $$\begin{cases} \frac{6}{x+y}+\frac{5}{y+3z}=2 \\ \frac{15}{x+y}-\frac{4}{x-2z}=\frac{1}{2} \\ \frac{10}{y+3z}-\frac{7}{x-2z}=-\frac{3}{2} \end{cases}$$

(Answer . $x=4; y=2; z=1.)$

6) $$\begin{cases} \frac{12}{2x+3y}-\frac{15}{6x+8z}=1 \\ \frac{30}{3x+4z}+\frac{37}{5y+9z}=3 \\ \frac{222}{5y+9z}-\frac{8}{2x+3y}=5 \end{cases}$$

(Answer . $x=1; y=2; z=3.)$

7) $$\begin{cases} \frac{5}{2x+y}+\frac{2}{3y-z}-\frac{2}{5x-z}=\frac{1}{20} \\ \frac{10}{2x+y}+\frac{5}{3y-z}-\frac{3}{5x-z}=\frac{2}{5} \\ \frac{10}{2x+y}-\frac{1}{3y-z}-\frac{3}{5x-z}=-\frac{1}{5} \end{cases}$$

(Answer . $x=5; y=10; z=20.)$

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