* What Is Linear eq^n?

A linear equation is the eq^n written in the form

$$ax+b=0$$

where a, b are real numbers and x is variables

∴ This form is sometime called Standard form of linear equation.

System of linear eqⁿ:-

A system of linear equation is when we have two or more linear equation working together.

$a_1x + b_1y + c_1z = d_1$

$a_2x + b_2y + c_2z = d_2$

$a_3x + b_3y + c_3z = d_3$

This is standard form of system of linear eqⁿ.

x, y, z = variable

$a_1, b_1, c_1, a_2, b_2, c_2, a_3, b_3, c_3$ and $c_1 c_3$ is constant Numerical value.

This system of linear eqⁿ we write into form of

$AX = B$

$$\begin{bmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} d_1 \\ d_2 \\ d_3 \end{bmatrix}$$

Working Rule

3 Let we the following system of linear eqⁿ.

→ $a_1x + b_1y + c_1z = d_1$

$a_2x + b_2y + c_2z = d_2$

$a_3x + b_3y + c_3z = d_3$

$a_1, a_2 \ldots a_3$, b_1, b_2, b_3 & $c_1 c_2 c_3$ are the coefficient of x, y, z simaltenously Respectively.

$d_1 d_2 d_3$ are constant Numerical values.

we write above eqⁿ into matrx form.

$x = 3.634240.$

Lineae Equation - Cramer's rule:-

- Cramer's rule is an algorithm for solving linear system using determinants.
- Cramer's rule can only be used with linear system that have exactly one sol^n.
- Cramer's rule is named after Gabriel Cramer's a swiss mathematician.
- It uses determinants to find the sol^n of linear eq^n system
- Given a system of linear equation, Cramer's rule is a handy way to solve just one of the variable without having to solve the whole system of equation

i.e Instead of solving the entire system of equation you can use Cramer's rule to solve for just one single variables.

working Rule

Let we the following system of linear eq^n.

→ $a_1x + b_1y + c_1z = d_1$
$a_2x + b_2y + c_2z = d_2$
$a_3x + b_3y + c_3z = d_3$

$a_1, a_2 .. a_3$, b_1, b_2, b_3 & $c_1 c_2 c_3$ are the coefficient of x_1 y_1 z simaltenously Respectively.

d_1 d_2 d_3 are constant Numerical values

we write above eq^n into materx form.

$$\begin{bmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{bmatrix} \rightarrow \text{coefficient } \cancel{\text{of}} \text{ matrix.}$$

$$= \begin{bmatrix} d_1 \\ d_2 \\ d_3 \end{bmatrix} \longrightarrow \text{constant value matrix.}$$

take

$$D = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$$

$$D_x = \begin{vmatrix} d_1 & b_1 & c_1 \\ d_2 & b_2 & c_2 \\ d_3 & b_3 & c_3 \end{vmatrix} \qquad D_y = \begin{vmatrix} a_1 & d_1 & c_1 \\ a_2 & d_2 & c_2 \\ a_3 & d_3 & c_3 \end{vmatrix}$$

$$D_z = \begin{vmatrix} a_1 & b_1 & d_1 \\ a_2 & b_2 & d_2 \\ a_3 & b_3 & d_3 \end{vmatrix}$$

standard way to find determinant :-

$$D = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$$

$$= a_1 \begin{vmatrix} b_2 & c_2 \\ b_3 & c_3 \end{vmatrix} - b_2 \begin{vmatrix} a_2 & c_2 \\ a_3 & c_3 \end{vmatrix} + c_1 \begin{vmatrix} a_2 & b_2 \\ a_3 & b_3 \end{vmatrix}$$

$$= a_1 [(b_2 c_3) - (b_3 c_2)] - b_2 [a_2 c_3 - a_3 c_2] + c_1 [a_2 b_3 - a_3 b_2]$$

IIIry we calculate D_x, D_y, D_z

according to crimers Rule.

$$\boxed{x = \frac{D_x}{D} \qquad y = \frac{D_y}{D} \qquad z = \frac{D_z}{D}}$$

Let use the following system of Linear equation.

$2x+y+z=3$
$x-y-z=0$
$x+2y+z=0$

- we have the left hand side of the System with the variables and right hand side with the numerical values (Answer value).

∴ Let D be determinant of the coefficient matrix.

Solⁿ:- ∴ system of eqⁿ

$2x+y+z=3$
$1x+1y-1z=0$
$1x+2y+1z=0$

coefficient Matrix ~~determinant~~

$$\begin{array}{c} \begin{array}{ccc} x & y & z \end{array} \\ \begin{bmatrix} 2 & 1 & 1 \\ 1 & -1 & -1 \\ 1 & 2 & 1 \end{bmatrix} \end{array}$$

Answer column value

$$\begin{bmatrix} 3 \\ 0 \\ 0 \end{bmatrix}$$

∴ coefficient matrix determinant

$$D = \begin{vmatrix} 2 & 1 & 1 \\ 1 & -1 & -1 \\ 1 & 2 & 1 \end{vmatrix}$$

∴ Dx is defined coefficient determinant with answer column values in x column.

∴ we get $Dx = \begin{vmatrix} 3 & 1 & 1 \\ 0 & -1 & -1 \\ 0 & 2 & 1 \end{vmatrix}$

IIIry Dy an Dz

$$D_y = \begin{vmatrix} 2 & 3 & 1 \\ 1 & 0 & -1 \\ 1 & 0 & 1 \end{vmatrix} \quad \text{and} \quad D_z \begin{vmatrix} 2 & 1 & 3 \\ 1 & -1 & 0 \\ 1 & 2 & 0 \end{vmatrix}$$

∴ Evaluating each determinant we get.

$$D = \begin{vmatrix} 2 & 1 & 1 \\ 1 & -1 & -1 \\ 1 & 2 & 1 \end{vmatrix} = 2\begin{vmatrix} -1 & -1 \\ 2 & 1 \end{vmatrix} - 1\begin{vmatrix} 1 & -1 \\ 1 & 1 \end{vmatrix} + 1\begin{vmatrix} 1 & -1 \\ 1 & 2 \end{vmatrix}$$

$$= 2(-1+2)] - 1[1-(-1)] + 1[2-(-1)]$$

$$= 2(-1+2) - 1[(1+1)] + 1[2+1]$$

$$= 2(1) - 1(2) + 1(3)$$

$$= 2 - 2 + 3$$

$$\boxed{D = 3}$$

$$D_x = \begin{vmatrix} 3 & 1 & 1 \\ 0 & -1 & -1 \\ 0 & 2 & 1 \end{vmatrix} = 3\begin{vmatrix} -1 & -1 \\ 2 & 1 \end{vmatrix} - 1\begin{vmatrix} 0 & -1 \\ 0 & 1 \end{vmatrix} + 1\begin{vmatrix} 0 & -1 \\ 0 & 2 \end{vmatrix}$$

$$= 3[-1-(-2)] - 1[0-0] + 1[0-0]$$

$$= 3(-1+2) - 1(0) + 1(0)$$

$$= 3(1) - 0 + 0$$

$$\boxed{D_x = 3}$$

IIIry
$$D_y = \begin{vmatrix} 2 & 3 & 1 \\ 1 & 0 & -1 \\ 1 & 0 & 1 \end{vmatrix} = 2\begin{vmatrix} 0 & -1 \\ 0 & 1 \end{vmatrix} - 3\begin{vmatrix} 1 & -1 \\ 1 & 1 \end{vmatrix} + 1\begin{vmatrix} 1 & 0 \\ 1 & 0 \end{vmatrix}$$

$= 2(0-0) - 3[(1-(-1)] + 1[(0-0)]$

$= 2(0) - 3(2) + 1(0)$

$= 0 - 6 + 0$

$\boxed{Dy = -6}$

$\therefore Dz = \begin{vmatrix} 2 & 1 & 3 \\ 1 & -1 & 0 \\ 1 & 2 & 0 \end{vmatrix} = 2\begin{vmatrix} -1 & 0 \\ 2 & 0 \end{vmatrix} - 1\begin{vmatrix} 1 & 0 \\ 1 & 0 \end{vmatrix} + 3\begin{vmatrix} 1 & -1 \\ 1 & 2 \end{vmatrix}$

$= 2[(0)-(0)] - 1[(0)-(0)] + 3[(2)-(-1)]$

$= 2(0) - 1(0) + 3(3)$

$= 0 - 0 + 9$

$\boxed{Dz = 9}$

according Cramer's rule

$x = Dx \div D$

$y = Dy \div D$

$z = Dz \div D$

$\therefore x = \frac{3}{3} = 1 \quad Dy = -\frac{6}{3} = -2 \quad Dz = \frac{Dz}{D} = \frac{9}{3} = 3$

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