اسم التدريسي : زهراء هاشم كريم

اسم المادة : رياضيات

عنوان المحاضرة: **Solution of simultaneous equations by using Cramers rule**

رقم المحاضرة:6

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Solution of simultaneous equations by using Cramers rule

Definition: Crammer 's rule uses a method of determinants to solve systems of equations.

Two simultaneous equations in x and y

$ax+by=p$

$cx+dy=q$

to solve use the following

then $x = \frac{D_x}{D}$, $y = \frac{D_y}{D}$

where:

$$D = \begin{vmatrix} a & b \\ c & d \end{vmatrix}, \quad D_x = \begin{vmatrix} p & b \\ q & d \end{vmatrix}, \quad D_y = \begin{vmatrix} a & p \\ c & q \end{vmatrix}$$

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Example 10:. Solve the system by Crammer's rule .

3x-y=9

x+2y=-4

solution:

$$D = \begin{vmatrix} 3 & -1 \\ 1 & 2 \end{vmatrix} = 6+1 = 7$$

$$D_x = \begin{vmatrix} 9 & -1 \\ -4 & 2 \end{vmatrix} = 18-4 = 14 \text{ , } D_y = \begin{vmatrix} 3 & 9 \\ 1 & -4 \end{vmatrix} = -12-9 = -21$$

$$x = \frac{14}{7} = 2 \quad , \quad y = \frac{-21}{7} = -3$$

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Three simultaneous equations in x , y and z

$$a_{11}x + a_{12}y + a_{13}z = b_1$$
$$a_{21}x + a_{22}y + a_{23}z = b_2$$
$$a_{31}x + a_{32}y + a_{33}z = b_3$$

To solve use the following

then $x = \frac{D_x}{D}$, $y = \frac{D_y}{D}$, $z = \frac{D_z}{D}$

where

$$D = \begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix} , \quad D_x = \begin{vmatrix} b_1 & a_{12} & a_{13} \\ b_2 & a_{22} & a_{23} \\ b_3 & a_{32} & a_{33} \end{vmatrix}$$

$$D_y = \begin{vmatrix} a_{11} & b_1 & a_{13} \\ a_{21} & b_2 & a_{23} \\ a_{31} & b_3 & a_{33} \end{vmatrix} , \quad D_z = \begin{vmatrix} a_{11} & a_{12} & b_1 \\ a_{21} & a_{22} & b_2 \\ a_{31} & a_{32} & b_3 \end{vmatrix}$$

Example 11:. Solve the system by using Crammer's rule .

$$2x + y + 3z = 9$$
$$x - 2y + z = -2$$
$$3x + 2y + 2z = 7$$

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Solution:

$$D = \begin{vmatrix} 2 & 1 & 3 \\ 1 & -2 & 1 \\ 3 & 2 & 2 \end{vmatrix} = 2\begin{vmatrix} -2 & 1 \\ 2 & 2 \end{vmatrix} - 1\begin{vmatrix} 1 & 1 \\ 3 & 2 \end{vmatrix} + 3\begin{vmatrix} 1 & -2 \\ 3 & 2 \end{vmatrix} = 13$$

$$D_x = \begin{vmatrix} 9 & 1 & 3 \\ -2 & -2 & 1 \\ 7 & 2 & 2 \end{vmatrix} = 9\begin{vmatrix} -2 & 1 \\ 2 & 2 \end{vmatrix} - 1\begin{vmatrix} -2 & 1 \\ 7 & 2 \end{vmatrix} + 3\begin{vmatrix} -2 & -2 \\ 7 & 2 \end{vmatrix} = -13$$

$$D_y = \begin{vmatrix} 2 & 9 & 3 \\ 1 & -2 & 1 \\ 3 & 7 & 2 \end{vmatrix} = 2\begin{vmatrix} -2 & 1 \\ 7 & 2 \end{vmatrix} - 9\begin{vmatrix} 1 & 1 \\ 3 & 2 \end{vmatrix} + 3\begin{vmatrix} 1 & -2 \\ 3 & 7 \end{vmatrix} = 26$$

$$D_z = \begin{vmatrix} 2 & 1 & 9 \\ 1 & -2 & -2 \\ 3 & 2 & 7 \end{vmatrix} = 2\begin{vmatrix} -2 & -2 \\ 2 & 7 \end{vmatrix} - 1\begin{vmatrix} 1 & -2 \\ 3 & 7 \end{vmatrix} + 9\begin{vmatrix} 1 & -2 \\ 3 & 2 \end{vmatrix} = 39$$

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H.W. Solve the system by using Crammer's rule .

1. $x - 3y = 6$
   $2x + 3y = 3$ ans. $x = 3$, $y = -1$

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

3. $3a + 4b - 3c = 2$
   $-2a + 2b + 2c = 15$
   $7a - 5b + 4c = 26$ ans. $x = 2.5$, $y = 3.5$, $z = 6.5$

4. $2x - 4y - 6 = 0$
   $x + y = 1 - z$