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Class: 3E1

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MA302.5.E2 (Adv) - Matrices Exercise

1. If $\begin{pmatrix} 3a & 2 \\ a & -a \end{pmatrix}$ is singular, find the possible values of a .

2. It is given that $3ax + 2y = 8$ and $ax - ay = k$, where a and k are real constants and $a \neq 0$.

(i) Determine the value of k if there are infinitely many solutions to the pair of simultaneous equations.

(ii) Use the matrix method to solve the simultaneous equations for x and y if $a = 1$ and $k = 6$.

3. Given that $\begin{pmatrix} 7 & -1 & -1 \\ -3 & m & 0 \\ -3 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 1 & 1 \\ 3 & 4 & 3 \\ 3 & 3 & 4 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$, show that $m = 1$. **Hence** solve the

following simultaneous equations:

$$x + y + z = 1$$

$$3x + 4y + 3z = 2$$

$$3x + 3y + 4z + 3 = 0$$



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1. determinant of $\begin{pmatrix} 3a & 2 \\ a & -a \end{pmatrix} = (3a)(-a) - (2)(a)$
 $= -3a^2 - 2a$

Since the matrix is singular, the determinant $= 0$

$$\therefore -3a^2 - 2a = 0$$

$$3a^2 + 2a = 0$$

$$a(3a+2) = 0$$

$$a = 0, \text{ or } -\frac{2}{3}$$

2. (i) $\begin{cases} 3ax + 2y = 8 \\ ax - ay = k \end{cases}$

$$\begin{pmatrix} 3ax & 2y \end{pmatrix} = \begin{pmatrix} 8 \\ k \end{pmatrix}$$

$$\begin{pmatrix} 3a & 2 \\ a & -a \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 8 \\ k \end{pmatrix}$$

For there to be infinitely as many solutions, the second row of the constant matrix have to be multiples of the first row.

$$\therefore k = \frac{8}{3}$$

(ii) Let $a=1$ and $k=b$

$$\therefore \begin{pmatrix} 3 & 2 \\ 1 & -1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 8 \\ b \end{pmatrix}$$

$$\frac{1}{\det \begin{pmatrix} 3 & 2 \\ 1 & -1 \end{pmatrix}} \begin{pmatrix} -1 & -2 \\ -1 & 3 \end{pmatrix} \begin{pmatrix} 3 & 2 \\ 1 & -1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \frac{1}{\det \begin{pmatrix} 3 & 2 \\ 1 & -1 \end{pmatrix}} \begin{pmatrix} -1 & -2 \\ -1 & 3 \end{pmatrix} \begin{pmatrix} 8 \\ b \end{pmatrix}$$

$$\begin{pmatrix} x \\ y \end{pmatrix} = -\frac{1}{5} \begin{pmatrix} -1 & -2 \\ -1 & 3 \end{pmatrix} \begin{pmatrix} 8 \\ b \end{pmatrix}$$

$$= \begin{pmatrix} 0.2 & 0.4 \\ 0.2 & -0.6 \end{pmatrix} \begin{pmatrix} 8 \\ b \end{pmatrix}$$

$$= \begin{pmatrix} 4 \\ -2 \end{pmatrix}$$

$$\therefore x = 4$$

$$y = -2$$



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3. The second row of the first will multiply the first row of the second matrix to get 0.

$$\therefore (-3 \ m \ 0) \begin{pmatrix} 1 \\ 3 \\ 3 \end{pmatrix} = 0$$

$$-3 \times 1 + 3m = 0$$

$$3m = 3$$

$$m = 1 \text{ (shown)}$$