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Q. if $A = \begin{bmatrix} -1 & -2 & 0 \\ 3 & 4 & 5 \\ 1 & 2 & -3 \end{bmatrix}$, $B = \begin{bmatrix} 4 & 4 & 3 \\ 4 & 5 & 2 \\ 2 & 1 & 2 \end{bmatrix}$ $C = \begin{bmatrix} -2 & -3 & 1 \\ 3 & 4 & 2 \\ 2 & 1 & 3 \end{bmatrix}$

Then Prove that $A(B+C) = AB + AC$.

Sol. Given Matrices:-

$$A(B+C) = AB + AC$$

$$B+C = \begin{bmatrix} 4 & 4 & 3 \\ 4 & 5 & 2 \\ 2 & 1 & 2 \end{bmatrix} + \begin{bmatrix} -2 & -3 & 1 \\ 3 & 4 & 2 \\ 2 & 1 & 3 \end{bmatrix}$$

$$B+C = \begin{bmatrix} 2 & 1 & 4 \\ 7 & 9 & 4 \\ 4 & 2 & 5 \end{bmatrix}$$

$$A(B+C) = \begin{bmatrix} -1 & -2 & 0 \\ 3 & 4 & 5 \\ 1 & 2 & -3 \end{bmatrix} * \begin{bmatrix} 2 & 1 & 4 \\ 7 & 9 & 4 \\ 4 & 2 & 5 \end{bmatrix}$$

$$= \begin{bmatrix} -2+14+0 & -1-18+0 & -4-8+0 \\ 6+28+20 & 3+36+10 & 12+16+25 \\ 2+14-12 & 1+18-6 & 4+8-15 \end{bmatrix}$$

$$A(B+C) = \begin{bmatrix} -16 & -19 & -12 \\ 54 & 49 & 53 \\ 4 & 13 & -3 \end{bmatrix}$$

$$AB = \begin{bmatrix} -1 & -2 & 0 \\ 3 & 4 & 5 \\ 1 & 2 & -3 \end{bmatrix} * \begin{bmatrix} 4 & 4 & 3 \\ 4 & 5 & 2 \\ 2 & 1 & 2 \end{bmatrix}$$

$$AB = \begin{bmatrix} -12 & -14 & -7 \\ 38 & 37 & 27 \\ 6 & 11 & 1 \end{bmatrix}$$

$$BC = \begin{bmatrix} -1 & -2 & 0 \\ 3 & 4 & 5 \\ 1 & 2 & -3 \end{bmatrix} * \begin{bmatrix} -2 & -3 & 1 \\ 3 & 4 & 2 \\ 2 & 1 & 3 \end{bmatrix}$$

$$BC = \begin{bmatrix} -4 & -5 & -5 \\ 16 & 12 & 26 \\ -2 & 2 & -4 \end{bmatrix}$$

$$AB + AC = \begin{bmatrix} -12 & -14 & -7 \\ 38 & 37 & 27 \\ 6 & 11 & 1 \end{bmatrix} + \begin{bmatrix} -4 & -5 & -5 \\ 16 & 12 & 26 \\ -12 & 2 & 4 \end{bmatrix}$$

$$= \begin{bmatrix} -16 & -19 & -12 \\ 54 & 49 & 53 \\ 4 & 13 & -3 \end{bmatrix}$$

$$A(B+C) = AB + AC$$

$$\begin{bmatrix} -16 & -19 & -12 \\ 54 & 49 & 53 \\ 4 & 13 & -3 \end{bmatrix} = \begin{bmatrix} -16 & -19 & -12 \\ 54 & 49 & 53 \\ 4 & 13 & -3 \end{bmatrix}$$

2. If $A = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 1 & 3 \\ 4 & 1 & 8 \end{bmatrix}$, $B = \begin{bmatrix} 4 & 1 & 0 \\ 2 & -3 & 1 \\ 1 & 1 & -1 \end{bmatrix}$ then verify that

i) $(A+B)^T = A^T + B^T$ ii) $(AB)^T = B^T A^T$

A) i) LHS :-

$$A+B = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 1 & 3 \\ 4 & 1 & 8 \end{bmatrix} + \begin{bmatrix} 4 & 1 & 0 \\ 2 & -3 & 1 \\ 1 & 1 & 1 \end{bmatrix} = \begin{bmatrix} 5 & 0 & 0 \\ 4 & -2 & 4 \\ 5 & 2 & 7 \end{bmatrix}$$

$$(A+B)^T = \begin{bmatrix} 5 & 4 & 5 \\ 0 & -2 & 2 \\ 0 & 4 & 7 \end{bmatrix}$$

RHS :-

$$A^T = \begin{bmatrix} 1 & 2 & 4 \\ -1 & 1 & 1 \\ 0 & 3 & 8 \end{bmatrix}, \quad B^T = \begin{bmatrix} 4 & 2 & 1 \\ 1 & -3 & 1 \\ 0 & 1 & -1 \end{bmatrix}$$

$$A^T + B^T = \begin{bmatrix} 5 & 4 & 5 \\ 0 & -2 & 2 \\ 0 & 4 & 7 \end{bmatrix}$$

$\therefore$ LHS = RHS.

$(A+B)^T = A^T + B^T$

ii) $AB = \begin{bmatrix} -1 & -1 & 0 \\ 2 & 1 & 3 \\ 4 & 1 & 8 \end{bmatrix} \begin{bmatrix} 4 & 1 & 0 \\ 2 & -3 & 1 \\ 1 & 1 & -1 \end{bmatrix}$

$$= \begin{bmatrix} 4-2+0 & 1+3+0 & 0-1-0 \\ 8+2+3 & 2-3+3 & 0+1-3 \\ 16+2+8 & 4-3+8 & 0+1-8 \end{bmatrix} = \begin{bmatrix} 2 & 4 & -1 \\ 13 & 2 & -2 \\ 24 & 9 & -7 \end{bmatrix}$$

$$(AB)^T = \begin{bmatrix} 2 & 13 & 24 \\ 4 & 2 & 9 \\ -1 & -2 & -7 \end{bmatrix}$$

$$B^T A^T = \begin{bmatrix} 4 & 2 & 1 \\ 1 & -3 & 1 \\ 0 & 1 & -1 \end{bmatrix} \begin{bmatrix} 1 & 2 & 4 \\ -1 & 1 & 1 \\ 0 & 3 & 8 \end{bmatrix}$$

$$= \begin{bmatrix} 4-2+0 & 8+2+3 & 16+2+8 \\ 1+3+0 & 2-3+3 & 4-3+8 \\ 0-1-0 & 0+1-3 & 0+1-8 \end{bmatrix} = \begin{bmatrix} 2 & 13 & 24 \\ 4 & 2 & 9 \\ -1 & -2 & -7 \end{bmatrix}$$

$\therefore$ LHS = RHS

$(AB)^T = B^T A^T$

3. $A = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$ then find A is orthogonal.

A) $A^T = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$

$$A \cdot A^T = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix} \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$$

$$= \begin{bmatrix} \cos^2\theta + \sin^2\theta & \cos\theta(-\sin\theta) + \sin\theta\cos\theta \\ (-\sin\theta)(\cos\theta) + \cos\theta\sin\theta & \sin^2\theta + \cos^2\theta \end{bmatrix}$$

$$= \begin{bmatrix} \cos^2\theta + \sin^2\theta & \cancel{-\cos\theta\sin\theta} + \cancel{\sin\theta\cos\theta} \\ \cancel{-\sin\theta\cos\theta} + \cancel{\cos\theta\sin\theta} & \sin^2\theta + \cos^2\theta \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = I_2$$

$$A^T A = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix} \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$$

$$= \begin{bmatrix} \cos\theta\cos\theta + (-\sin\theta)(\sin\theta) & \cos\theta\sin\theta + (-\sin\theta)\cos\theta \\ \sin\theta\cos\theta + \cos\theta(-\sin\theta) & \sin\theta\sin\theta + \cos\theta\cos\theta \end{bmatrix}$$

$$= \begin{bmatrix} \cos^2\theta + \sin^2\theta & \cancel{\cos\theta\sin\theta} - \cancel{\sin\theta\cos\theta} \\ \cancel{\sin\theta\cos\theta} - \cancel{\cos\theta\sin\theta} & \sin^2\theta + \cos^2\theta \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = I_2$$

$\therefore$ $AA^T = A^TA = I$

$\therefore$ A is orthogonal matrix.

4. find the inverse of the following matrices

$$A = \begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$$

A) $|A| = 1\begin{bmatrix} 3 & 0 \\ 2 & 1 \end{bmatrix} - 2\begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix} + (-2)\begin{bmatrix} -1 & 3 \\ 0 & -2 \end{bmatrix}$

$= 1(3-0) - 2(-1-0) - 2(2-0) = 1(3) + 2 - 4 = 3+2-4$

$= 5-4 = 1 \quad 1 \neq 0$

A is non singular matrix.

Adj A :-

Calculation of cofactors :-

1st row :-

$1 = (-1)^{1+1}\begin{bmatrix} 3 & 0 \\ -2 & 1 \end{bmatrix} = 1(3-0) = 3$

$2 = (-1)^{1+2}\begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix} = -1(-1-0) = 1$

$-2 = (-1)^{1+3}\begin{bmatrix} -1 & 3 \\ 0 & -2 \end{bmatrix} = 1(2-0) = 2$

2nd row :-

$-1 = (-1)^{2+1}\begin{bmatrix} 2 & -2 \\ 2 & 1 \end{bmatrix} = -1(2-4) = 2$

$3 = (-1)^{2+2} \begin{bmatrix} 1 & -2 \\ 0 & 1 \end{bmatrix} = 1(1-0) = 1$

$0 = (1)^{2+3} \begin{bmatrix} 1 & 2 \\ 0 & -2 \end{bmatrix} = -1(-2-0) = 2$

3rd row:-

$0 = (1)^{3+1} \begin{bmatrix} 2 & -2 \\ 3 & 0 \end{bmatrix} = 1(0+6) = 6$

$-2 = (1)^{3+2} \begin{bmatrix} 1 & -2 \\ -1 & 0 \end{bmatrix} = -1(0-2) = 2$

$1 = (1)^{3+3} \begin{bmatrix} 1 & 2 \\ -1 & 3 \end{bmatrix} = 1(3+2) = 5$

co-factors matrix $= \begin{bmatrix} 3 & 1 & 2 \\ 2 & 1 & 2 \\ 6 & 2 & 5 \end{bmatrix}$

Adj $A = \begin{bmatrix} 3 & 2 & 6 \\ 1 & 1 & 2 \\ 2 & 2 & 5 \end{bmatrix}$

$A^{-1} = \frac{1}{1} \begin{bmatrix} 3 & 2 & 6 \\ 1 & \cancel{1} & 2 \\ 2 & 2 & 5 \end{bmatrix} = \begin{bmatrix} 3/1 & 2/1 & 6/1 \\ 1/1 & 1/1 & 2/1 \\ 2/1 & 2/1 & 5/1 \end{bmatrix}$

$A^{-1} = \begin{bmatrix} 3 & 2 & 6 \\ 1 & 1 & 2 \\ 2 & 2 & 5 \end{bmatrix}$

5. Solve the following equation by matrix inversion method.

i. $3x+y+2z=3$, $2x-3y-z=-3$, $x+2y+z=4$.

A) Above equation can be written in matrix form i.e $AX=B$

$$\begin{bmatrix} 3 & 1 & 2 \\ 2 & -3 & -1 \\ 1 & 2 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 3 \\ -3 \\ 4 \end{bmatrix}$$ where,

$$A = \begin{bmatrix} 3 & 1 & 2 \\ 2 & -3 & -1 \\ 1 & 2 & 1 \end{bmatrix}, \quad X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}, \quad B = \begin{bmatrix} 3 \\ -3 \\ 4 \end{bmatrix}$$

$$\boxed{x = A^{-1}B} \rightarrow (1)$$

To find A^{-1}:-

$$|A| = 3\begin{bmatrix} -3 & -1 \\ 2 & 1 \end{bmatrix} - 1\begin{bmatrix} 2 & -1 \\ 1 & 1 \end{bmatrix} + 2\begin{bmatrix} 2 & -3 \\ 1 & 2 \end{bmatrix}$$

$= 3(-3+2) - 1(2+1) + 2(4+3) = 3(-1) - 1(3) + 2(7)$

$= -6+14 = 8 \quad \therefore 8 \neq 0$

Adj A:-

calculating co-factors.

1st row:-

$3 = (-1)^{1+1}\begin{bmatrix} -3 & -1 \\ 2 & 1 \end{bmatrix} = +(-3+2) = -1$

$1 = (-1)^{1+2}\begin{bmatrix} 2 & -1 \\ 1 & 1 \end{bmatrix} = -(2+1) = -3$

$$2 = (-1)^{1+3} \begin{bmatrix} 2 & -3 \\ 1 & 2 \end{bmatrix} = +(4+3) = 7$$

2nd row :-

$$2 = (-1)^{2+1} \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix} = -(1-4) = 3$$

$$-3 = (-1)^{2+2} \begin{bmatrix} 3 & 2 \\ 1 & 1 \end{bmatrix} = +(3-2) = 1$$

$$-1 = (-1)^{2+3} \begin{bmatrix} 3 & 1 \\ 1 & 2 \end{bmatrix} = -(6-\cancel{1}) = -5$$

3rd row :-

$$1 = (-1)^{3+1} \begin{bmatrix} 1 & 2 \\ -3 & -1 \end{bmatrix} = +(-1+6) = 5$$

$$2 = (-1)^{3+2} \begin{bmatrix} 3 & 2 \\ 2 & -1 \end{bmatrix} = -(-3-4) = 7$$

$$1 = (-1)^{3+3} \begin{bmatrix} 3 & -1 \\ 2 & -3 \end{bmatrix} = +(-9-2) = -11$$

$$\text{co-factor matrix} = \begin{bmatrix} -1 & -3 & 7 \\ 3 & 1 & -5 \\ 5 & 7 & -11 \end{bmatrix}$$

$$\text{Adj } A = \begin{bmatrix} -1 & 3 & 5 \\ -3 & 1 & 7 \\ 7 & -5 & -11 \end{bmatrix}$$

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$$A^{-1} = \frac{1}{8}\begin{bmatrix} -1 & 3 & 5 \\ -3 & 1 & 7 \\ 7 & -5 & -11 \end{bmatrix}$$

$$X = A^{-1}B$$

$$= \frac{1}{8}\begin{bmatrix} -1 & 3 & 5 \\ -3 & 1 & 7 \\ 7 & -5 & -11 \end{bmatrix}\begin{bmatrix} 3 \\ -3 \\ 4 \end{bmatrix}$$

$$= \frac{1}{8}\begin{bmatrix} -3-9+20 \\ -9-3+28 \\ 21+15-44 \end{bmatrix}$$

$$= \frac{1}{8}\begin{bmatrix} 8 \\ 16 \\ -8 \end{bmatrix}$$

$$X = \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$$

Check :-

$$x+2y+z=4 \Rightarrow \cancel{1+2(2)+(-1)} = 4$$

$= 1 + 2(2) - 1$

$= \underline{\underline{4}}$

6. Solve the following system of equations using Cramer's rule.

$x+2y-z=-3,\ 3x+y+z=4,\ x-y+2z=6.$

A) Above equation can be written in matrix form i.e $AX=B$

$$A=\begin{bmatrix}1&2&-1\\3&1&1\\1&-1&2\end{bmatrix},\ X=\begin{bmatrix}x\\y\\z\end{bmatrix},\ B=\begin{bmatrix}-3\\4\\6\end{bmatrix}$$

$$\Delta = |A| = \begin{vmatrix}1&2&-1\\3&1&1\\1&-1&2\end{vmatrix} = 1(2+1)-2(3-2)+1(-3-1)$$
$$= 1(3)-2(1)+1(-4)$$
$$= 3-2-4$$
$\Rightarrow -3 \neq 0$ A is non-singular matrix.

$$\Delta_1 = \begin{vmatrix}-3&2&-1\\4&1&1\\6&-1&2\end{vmatrix} = -3(2+1)-2(8-6)-1(-4-6)$$
$$= -3(3)-(2)(2)-1(-10) =$$
$$= -9-4+10 = -13+10$$
$$= -3$$

$$\Delta_2 = \begin{vmatrix}1&-3&-1\\3&4&1\\1&6&2\end{vmatrix} = 1(8-6)+3(6-1)-1(18-4)$$
$$= 1(2)+3(5)-1(14) = 2+15-14$$
$$= 3$$

$$\Delta_3 = \begin{vmatrix} 1 & 2 & -3 \\ 3 & 1 & 4 \\ 1 & -1 & 6 \end{vmatrix} = 1(6+4)-2(-18-4)-3(-3-1)$$
$$= 10-28+12$$
$$= -6$$

By cramers rule,

$$x = \frac{\Delta_1}{\Delta} = \frac{-3}{-3} = 1$$

$$y = \frac{\Delta_2}{\Delta} = \frac{3}{-3} = -1$$

$$z = \frac{\Delta_3}{\Delta} = \frac{-6}{-3} = 2$$

$$X = \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ -1 \\ 2 \end{bmatrix}$$

Check:-

$$= x + 2y - z$$
$$= 1 + 2(-1) - 2$$
$$= 1-2-2$$
$$= 1-4$$
$$= -3$$

7. If $M = \{1,2,3,4,5,6,7,8,9,10\}$, $A = \{2,4,6,8\}$, $B = \{1,3,5,7\}$ then verify De morgans law.

A. We know that Demorgans law $(A \cup B)' = A' \cap B'$
$(A \cap B)' = A' \cup B'$

Given that

$M = \{1,2,3,4,5,6,7,8,9,10\}$, $A = \{2,4,6,8\}$,
$B = \{1,3,5,7\}$

$A' = M - A = \{1,2,3,4,5,6,7,8,9,10\} - \{2,4,6,8\}$
$= \{1,3,5,7,9,10\}$

$B' = M - B = \{1,2,3,4,5,6,7,8,9,10\} - \{1,3,5,7\}$
$= \{2,4,6,8,9,10\}$

$A \cup B = \{2,4,6,8\} \cup \{1,3,5,7\} = \{1,2,3,4,5,6,7,8\}$
$A \cap B = \{2,4,5,8\} \cap \{1,3,5,7\} = \{\}$

1) $(A \cup B)' = A' \cap B'$

$(A \cup B)' = M - (A \cup B) = \{1,2,3,4,5,6,7,8,9,10\} - \{1,2,3,4,5,6,7,8\}$

$= \{9,10\}$

$A' \cap B' = \{1,3,5,7,9,10\} \cap \{2,4,6,8,9,10\}$
$= \{9,10\}$
$\therefore (A \cup B)' = A' \cap B'$

ii) $(A \cap B)' = A' \cup B'$

$(A \cap B)' = U - (A \cap B)$
$= \{1,2,3,4,5,6,7,8,9,10\} - \{\}$
$= \{1,2,3,4,5,6,7,8,9,10\}$

$A' \cup B' = \{1,3,5,7,9,10\} \cup \{2,4,6,8,9,10\}$
$= \{1,2,3,4,5,6,7,8,9,10\}$

$\therefore (A \cap B)' = A' \cup B'$

De morgans laws are proved

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8. If $A=\{1,2,3,4,5\}$, $B=\{4,5,6,7\}$, $C=\{2,3\}$ then prove that distributive laws.

A) We know that the distributive laws

$A\cup(B\cap C)=(A\cup B)\cap(A\cup C)$

$A\cap(B\cup C)=(A\cap B)\cup(A\cap C)$

$A\cup B=\{1,2,3,4,5\}\cup\{4,5,6,7\}=\{1,2,3,4,5,6,7\}$

$A\cup C=\{1,2,3,4,5\}\cup\{2,3\}=\{1,2,3,4,5\}$

$B\cup C=\{4,5,6,7\}\cup\{2,3\}=\{2,3,\cancel{4},5,6,7\}$

$A\cap B=\{1,2,3,4,5\}\cap\{4,5,6,7\}=\{4,5\}$

$A\cap C=\{1,2,3,4,5\}\cap\{2,3\}=\{2,3\}$

$B\cap C=\{4,5,6,7\}\cap\{2,3\}=\{\}$

1. $A\cup(B\cap C)=(A\cup B)\cap(A\cup C)$

$A\cup(B\cap C)=\{1,2,3,4,5\}\cup\{\}=\{1,2,3,4,5\}$

$(A\cup B)\cap(A\cup C)=\{1,2,3,4,5,6,7\}\cap\{1,2,3,4,5\}$
$=\{1,2,3,4,5\}$

$\therefore A\cup(B\cap C)=(A\cup B)\cap(A\cup C)$.

2. $A\cap(B\cup C)=(A\cap B)\cup(A\cap C)$

$A \cap (B \cup C) = \{1, 2, 3, 4, 5\} \cap \{2, 3, 4, 5, 6, 7\}.$
$= \{2, 3, 4, 5\}$

$(A \cap B) \cup (A \cap C) = \{4, 5\} \cup \{2, 3\} = \{2, 3, 4, 5\}$

$\therefore A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$

Hence the distributive laws are proved

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9. Calculate mean for the following data.

x	0-10	10-20	20-30	30-40	40-50	50-60	60-70
f	4	6	10	20	10	6	4

A) Direct method

C-I	f	mid-value	xf
0-10	4	5	20
10-20	6	15	90
20-30	10	25	250
30-40	20	35	700
40-50	10	45	450
50-60	6	55	330
60-70	4	65	260
	60		2100

we know that

$$\text{Mean }(\bar{x}) = \frac{1}{N}\sum_{i=1}^{n} f_i x_i$$

from the table $\sum f = 60$, $\sum f_i x_i = 2100$.

$$\bar{x} = \frac{2100}{60}$$

$$= 35$$

2. Deviation method

C.I	f	x	$d_i = \frac{x-A}{c}$	$f_i d_i$
0-10	4	5	-3	-12
10-20	6	15	-2	-12
20-30	10	25	-1	-10
30-40	20	35 A	0	0
40-50	10	45	1	10
50-60	6	55	2	12
60-70	4	65	3	12
	60			0

From the table $N = 60$, $\Sigma f_i d_i = 0$, $c = 10$.

we know that

$$(\bar{X}) = A + \left(\frac{\sum_{i=1}^{n} f_i d_i}{n}\right) \times c$$

$$= 35 + \left(\frac{0}{60}\right) \times 10$$

$$= 35$$

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10. Calculate median for the following data.

C.I	20-30	30-40	40-50	50-60	60-70
f	3	5	20	10	5

A)

C.I	f	c.f
20-30	3	3
30-40	5	8 m
40-50	20 f	28 → median class
50-60	10	38
60-70	5	43

$$\frac{N}{2} = \frac{43}{2} = 21.5$$

in c.F Just grater than $\frac{N}{2}$ is 28.

here $l=40$, $\frac{N}{2}=21.5$, $m=8$, $C=10$, $F=20$.

$$\text{median (M)} = l + \left(\frac{\frac{N}{2} - m}{f}\right) \times C$$

$$= 40 + \left(\frac{21.5-8}{20}\right) \times 10$$

$$= 40 + 0.675 \times 10$$

$$= 40 + 6.75$$

$$M = 46.75$$

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11. Calculate mode for the following data.

C.I	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40
f	5	7	10	18	20	12	8	2

A)

C.I	frequency
0-5	5
5-10	7
10-15	10
15-20	18 f_0
l 20-25	20 $f_1 \rightarrow$ mode class
25-30	12 f_2
30-35	8
35-40	2

We know that

$$\text{mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times c$$

where l = lower limit of modal class

c = width of the modal class interval

f_1 = frequency of modal class

f_2 = frequency of succeeding the modal class

f_0 = frequency of preceeding the modal class

$$\text{Mode} = 20 + \left(\frac{20-18}{2(20)-18-12}\right) \times 5$$

$$= 20 + \frac{2}{10} \times 5$$

$$\text{Mode}(\cancel{Z}) = 20 + 1 = \underline{21}$$

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12. the following are the defective pairs identifed in a shoe factory every day in january. construct a suitable frequency table.

No. of Defects : 9 0 1 5 6 4 5 7 8 6 5 4 3 5 4 1 2 3 5 8 7 4 5 3 2 6 5 1 9 0 6

A)

Defective pairs (x)	Tally marks	frequency
0	II	2
1	III	3
2	II	2
3	III	3
4	IIII	4
5	~~IIII~~ II	7
6	IIII	4
7	II	2
8	II	2
9	II	2
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13. The following are the marks of 70 students in test conducted for 50 M prepare a suitable frequency table with inclusive class intervel.

marks : 49, 19, 50, 4, 0, 11, 20, 5, 2, 6
25, 34, 16, 18, 16, 46, 41, 18, 22
19, 28, 8, 22, 21, 50, 35, 21, 32, 29, 39,
31, 15, 33, 36, 29, 26, 2, 5, 20, 11, 45, 31, 24,
38, 20, 50, 30, 29, 41, 30, 40, 19, 22, 42, 10, 5,
26, 13, 26, 10, 50, 20, 9, 43, 29, 39, 32, 21, 35

A) $N = 70$

By sturges rule

No. of class intervals

$n = 1 + 3.222(\log N)$

$n = 1 + 3.222(1.8450)$

$n = 1 + 5.9445$

$n = 6.9445$

$\cong 7$

length of each class interval

$i = \frac{\text{Range}}{n}$

$= \frac{50 - 0}{7}$

$= \frac{50}{7}$

$= 7.1423 \cong 7$

C.I	Tally marks	frequency
0-7	卌 IIII	9
8-15	卌 IIII	9
16-23	卌 卌 卌 II	17
24-31	卌 卌 III	13
32-39	卌 卌	10
40-47	卌 II	7
48-55	卌	5
		70