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CHAPTER NOTES

Determinants Class 12 Notes — CBSE Maths Chapter 4

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Determinants Class 12 Notes — CBSE Maths Chapter 4

Chapter 4 — **Determinants** — covers evaluation, properties, area of triangles, adjoint, inverse of matrices, and solving linear equations using Cramer's rule. Carries **8-10 marks** — one of the highest-scoring chapters.

Key Concepts

Determinant Evaluation

2x2: $\begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$

3x3 (expansion along R_1):

$$|A| = a_{11}(A_{11}) - a_{12}(A_{12}) + a_{13}(A_{13})$$

Where $A_{ij} = (-1)^{i+j} \times M_{ij}$ (cofactor), M_{ij} = minor

Properties of Determinants

1. $|A^T| = |A|$
2. Interchanging rows/columns changes sign
3. Two identical rows/columns $\rightarrow |A| = 0$
4. Scalar multiplication of a row: multiplies determinant by that scalar
5. $|kA| = k^n|A|$ for $n \times n$ matrix
6. Row/column operation $R_i \rightarrow R_i + kR_j$ doesn't change value
7. $|AB| = |A| \times |B|$

Area of Triangle

$$\text{Area} = \frac{1}{2} |x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)|$$

$$\text{Or using determinant: Area} = \frac{1}{2} \begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$$

Points are collinear if Area = 0

Adjoint and Inverse

$\text{adj}(\mathbf{A})$ = transpose of cofactor matrix

$\mathbf{A}^{-1} = (1/|\mathbf{A}|) \times \text{adj}(\mathbf{A})$ (exists only when $|\mathbf{A}| \neq 0$)

Properties: $\mathbf{A} \times \text{adj}(\mathbf{A}) = |\mathbf{A}| \times \mathbf{I}$

$|\text{adj}(\mathbf{A})| = |\mathbf{A}|^{n-1}$ (for $n \times n$ matrix)

$(\mathbf{AB})^{-1} = \mathbf{B}^{-1}\mathbf{A}^{-1}$

System of Linear Equations ($\mathbf{AX} = \mathbf{B}$)

$\mathbf{X} = \mathbf{A}^{-1}\mathbf{B}$ (unique solution when $|\mathbf{A}| \neq 0$)

Cramer's Rule:

$x = D_1/D, y = D_2/D, z = D_3/D$

Where $D = |\mathbf{A}|$, $D_1 = |\mathbf{A}|$ with column 1 replaced by $\mathbf{B}$, etc.

If $|\mathbf{A}| = 0$: system is either inconsistent (no solution) or has infinite solutions

Solved Examples

Example 1

Q: Find the inverse of $\mathbf{A} = \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix}$

Solution:

$|\mathbf{A}| = 8 - 3 = 5 \neq 0 \rightarrow$ inverse exists

$\text{adj}(\mathbf{A}) = \begin{bmatrix} 4 & -3 \\ -1 & 2 \end{bmatrix}$

$\mathbf{A}^{-1} = (1/5) \begin{bmatrix} 4 & -3 \\ -1 & 2 \end{bmatrix} = \begin{bmatrix} 4/5 & -3/5 \\ -1/5 & 2/5 \end{bmatrix}$

Example 2

Q: Using determinants, find the area of triangle with vertices $(1,0)$, $(6,0)$, $(4,3)$.

Solution: Area = $\frac{1}{2}|1(0-3) + 6(3-0) + 4(0-0)| = \frac{1}{2}|-3 + 18 + 0| = \frac{1}{2}(15) = 7.5 \text{ sq units}$

Quick Revision Points

- 2×2 : $ad-bc$; 3×3 : expand along any row/column
- $|kA| = k^n|A|$; $|AB| = |A||B|$; $|A^T| = |A|$
- $A^{-1} = \text{adj}(A)/|A|$; exists only if $|A| \neq 0$ (non-singular)
- Cramer's rule: $x = D_1/D$, $y = D_2/D$, $z = D_3/D$
- Area of triangle using determinant = $\frac{1}{2}|\det|$; collinear if = 0

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