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Determinants

Collection of numbers in square form

$$D = \begin{vmatrix} 2 & -1 & -3 & 4 \\ -5 & 6 & -0 & 2 \\ -1 & 1 & 3 & 1 \\ 7 & \frac{3}{2} & 2 & 5 \end{vmatrix}$$

row

column

4×4

D_4

$D_{4\times4}$

Order of determinant $= 4$

$$\begin{vmatrix} x & x & x \\ x & x & x \end{vmatrix}$$

not a determinant

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Minor

$$D_n = \begin{vmatrix} a_{11} & a_{12} & a_{13} & \cdots & a_{1n} \\ a_{21} & a_{22} & a_{23} & \cdots & a_{2n} \\ a_{31} & a_{32} & a_{33} & \cdots & a_{3n} \\ \vdots & \vdots & \vdots & & \\ a_{n1} & a_{n2} & a_{n3} & \cdots & a_{nn} \end{vmatrix}$$

$$M_{11} = \begin{vmatrix} a_{22} & a_{23} & \cdots & a_{2n} \\ a_{32} & a_{33} & \cdots & a_{3n} \\ \vdots & & & \\ a_{n2} & a_{n3} & \cdots & a_{nn} \end{vmatrix}$$

$$M_{23} = \begin{vmatrix} a_{11} & a_{12} & a_{14} & \cdots & a_{1n} \\ a_{31} & a_{32} & a_{34} & \cdots & a_{3n} \\ \vdots & & & & \\ a_{n1} & a_{n2} & a_{n4} & \cdots & a_{nn} \end{vmatrix}$$

a_{ij}: $i \to$ row, $j \to$ column

Cofactor.

$$C_{ij} = (-1)^{i+j} M_{ij}$$

$$D = \begin{vmatrix} a_{11} & a_{12} \\ & \end{vmatrix}$$

$$\begin{vmatrix} a_{11} & a_{12} & a_{13} & \cdots & a_{1n} \\ a_{21} & a_{22} & a_{23} & \cdots & a_{2n} \\ a_{31} & a_{32} & a_{33} & \cdots & a_{3n} \\ \vdots & & & & \\ a_{n1} & a_{n2} & a_{n3} & \cdots & a_{nn} \end{vmatrix} = a_{11}C_{11} + a_{12}C_{12} + a_{13}C_{13} + \cdots a_{1n}C_{1n}$$

$$= a_{31}C_{31} + a_{32}C_{32} + \cdots + a_{3n}C_{3n}$$

$$= a_{12}C_{12} + a_{22}C_{22} + a_{32}C_{32} + \cdots + a_{n2}C_{n2}$$

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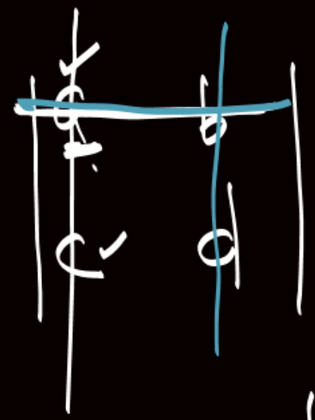

$$= ad + b(-c) = ad - bc$$

$$\begin{vmatrix} a & b \\ c & d \end{vmatrix} = b_1$$

$$\begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix} = b_1\left(-(a_2c_3 - a_3c_2)\right) + b_2\left(a_1c_3 - a_3c_1\right) + b_3\left(-(a_1c_2 - a_2c_1)\right)$$

$$b_1\left(-\begin{vmatrix} a_2 & a_3 \\ c_2 & c_3 \end{vmatrix}\right) + b_2\left(\begin{vmatrix} a_1 & a_3 \\ c_1 & c_3 \end{vmatrix}\right) + b_3\left(-\begin{vmatrix} a_1 & a_2 \\ c_1 & c_2 \end{vmatrix}\right)$$

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Ex-I (1-20) ✓