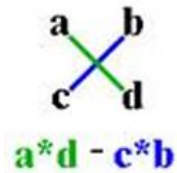


DETERMINANTS

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What are Determinants?



To every square matrix $A = [a_{ij}]$ of order n , we can associate a number (real or complex) called [determinant](#) of the [square matrix](#) A , where $a_{ij} = (i, j)^{\text{th}}$ element of A .

Determinant of a matrix of order one

Let $A = [a]$ be the matrix of [order](#) 1, then determinant of A is defined to be equal to 'a'.
For example: If $A = [5]$ then $|A| = 5$

Determinant of a matrix of order two

If $A = \begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix}$ then, determinant A is given by

$$|A| = \begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix} = a_{11} a_{22} - a_{21} a_{12}$$

For example: Evaluate $\begin{vmatrix} x & x+1 \\ x-1 & x \end{vmatrix}$

Answer: $\begin{vmatrix} x & x+1 \\ x-1 & x \end{vmatrix} = x^2 - (x^2 - 1)$
 $= x^2 - x^2 + 1 = 1$

Determinant of a matrix of order three

Determinant of a matrix of order three can be determined by expressing it in terms of second order determinants. This is known as expansion of a determinant along [row or a column](#). There are six ways of expanding a determinant of order 3 corresponding to each three rows and three columns. Commonly we use the expansion along R_1 (row 1).

$$\text{Let } A = \begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix}$$

$$|A| = a_{11} \begin{vmatrix} a_{22} & a_{23} \\ a_{32} & a_{33} \end{vmatrix} - a_{12} \begin{vmatrix} a_{21} & a_{23} \\ a_{31} & a_{33} \end{vmatrix} + a_{13} \begin{vmatrix} a_{21} & a_{22} \\ a_{31} & a_{32} \end{vmatrix}$$

$$= a_{11}(a_{22} \times a_{33} - a_{32} \times a_{23}) - a_{12}(a_{21} \times a_{33} - a_{31} \times a_{23}) + a_{13}(a_{21} \times a_{32} - a_{31} \times a_{22})$$

For example: Evaluate $\begin{vmatrix} 3 & -1 & -2 \\ 0 & 0 & -1 \\ 3 & -5 & 0 \end{vmatrix}$

Answer: $\begin{vmatrix} 3 & -1 & -2 \\ 0 & 0 & -1 \\ 3 & -5 & 0 \end{vmatrix}$

Here, $a_{11} = 3$, $a_{12} = -1$, $a_{13} = -2$

$a_{21} = 0$, $a_{22} = 0$, $a_{23} = -1$

$a_{31} = 3$, $a_{32} = -5$, $a_{33} = 0$

According to formula:

$$a_{11}(a_{22} \times a_{33} - a_{32} \times a_{23}) - a_{12}(a_{21} \times a_{33} - a_{31} \times a_{23}) + a_{13}(a_{21} \times a_{32} - a_{31} \times a_{22})$$

Substituting the values in the above formula, we get:

$$= 3(0 - 5) - (-1)(0 - (-3)) - 2(0 - 0) = -15 + 3 - 0 = -12$$

Try this:

What value of x makes the determinant 7?

$$\begin{vmatrix} -2 & 0 & 0 \\ -6 & x & 1 \\ -4 & 0 & -1 \end{vmatrix}$$

Now try it yourself! Should you still need any help, [click here](#) to schedule live online session with e Tutor!

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Reference Links:

- <http://en.wikipedia.org/wiki/Determinant>
- <http://www.britannica.com/EBchecked/topic/561660/square-matrix>
- http://www.mathreference.com/la-mpoly_order.html
- http://en.wikipedia.org/wiki/Row_and_column_spaces
-

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