

ASSIGNMENT 1

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Question 1.3.1 D_1 is a point on BC such that

$$AD_1 \perp BC$$

and is defined to be the altitude. Find the normal vector of AD_1 .

Solution: Given:

$$\mathbf{A} = \begin{pmatrix} 1 \\ -1 \end{pmatrix}, \mathbf{B} = \begin{pmatrix} -4 \\ 6 \end{pmatrix}, \mathbf{C} = \begin{pmatrix} -3 \\ -5 \end{pmatrix}. \quad (1)$$

(2)

The direction vector of BC :

$$\mathbf{BC} = \mathbf{C} - \mathbf{B} \quad (3)$$

$$= \begin{pmatrix} -3 \\ -5 \end{pmatrix} - \begin{pmatrix} -4 \\ 6 \end{pmatrix} \quad (4)$$

$$= \begin{pmatrix} 1 \\ -11 \end{pmatrix} \quad (5)$$

(6)

The normal vector of a given vector is calculated using the formula:

$$\mathbf{n} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \mathbf{BC} \quad (7)$$

Also given that

$$AD_1 \perp BC$$

Hence: Direction vector of normal to BC = Direction vector of AD_1 :

$$\Rightarrow \mathbf{n} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \begin{pmatrix} 1 \\ -11 \end{pmatrix} \quad (8)$$

$$= \begin{pmatrix} -11 \\ -1 \end{pmatrix} \quad (9)$$

Similarly,

Normal vector of AD_1 :

$$\Rightarrow \mathbf{n} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \begin{pmatrix} -11 \\ -1 \end{pmatrix} = \begin{pmatrix} -1 \\ 11 \end{pmatrix} \quad (10)$$

(11)

Therefore, normal vector of $AD_1 = \begin{pmatrix} -1 \\ 11 \end{pmatrix}$