

# Assignment-1

## Probability and Random Processes

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Question 1.1.3: Points A,B,C are defined to be collinear if

$$\text{rank} \begin{pmatrix} 1 & 1 & 1 \\ A & B & C \end{pmatrix} = 2 \quad (1)$$

Are the given points in (1.1) collinear?

**Solution:** Given,

$$A = \begin{pmatrix} 1 \\ -1 \end{pmatrix}, B = \begin{pmatrix} -4 \\ 6 \end{pmatrix}, C = \begin{pmatrix} -3 \\ -5 \end{pmatrix} \quad (2)$$

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

Evaluating rank of the matrix using echelon form:

$$\begin{pmatrix} 1 & 1 & 1 \\ 1 & -4 & -3 \\ -1 & 6 & -5 \end{pmatrix} \xrightarrow{R_2 \rightarrow R_2 - R_1} \begin{pmatrix} 1 & 1 & 1 \\ 0 & -5 & -4 \\ -1 & 6 & -5 \end{pmatrix} \quad (4)$$

$$\begin{pmatrix} 1 & 1 & 1 \\ 0 & -5 & -4 \\ -1 & 6 & -5 \end{pmatrix} \xrightarrow{R_3 \rightarrow R_3 + R_2 - R_1} \begin{pmatrix} 1 & 1 & 1 \\ 0 & -5 & -4 \\ 0 & 0 & -10 \end{pmatrix} \quad (5)$$

As the no. of non-zero rows are 3, the rank of the matrix is 3.

Hence,

$$\text{rank} \begin{pmatrix} 1 & 1 & 1 \\ A & B & C \end{pmatrix} \neq 2 \quad (6)$$

$\therefore$  The given points are not collinear.