

# Assignment-1

EE:23010 Probability and Random Processes  
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## I. QUESTION 1.2.4

Verify that

$$\frac{BG}{GE} = \frac{CG}{GF} = \frac{AG}{GD} = 2 \quad (1)$$

## II. SOLUTION

In order to verify the above equation we first need to find  $\mathbf{G}$ .  $\mathbf{G}$  is the intersection of  $BE$  and  $CF$  Using the value of  $\mathbf{G}$  from (1.2.3).

$$\mathbf{G} = \begin{pmatrix} -2 \\ 0 \end{pmatrix} \quad (2)$$

Also, We know that  $\mathbf{D}$ ,  $\mathbf{E}$  and  $\mathbf{F}$  are midpoints of  $BC$ ,  $CA$  and  $AB$  respectively from (1.2.1).

$$\mathbf{D} = \begin{pmatrix} -7 \\ 1 \\ 2 \end{pmatrix}, \mathbf{E} = \begin{pmatrix} -1 \\ -3 \end{pmatrix}, \mathbf{F} = \begin{pmatrix} -3 \\ 2 \\ 2 \end{pmatrix} \quad (3)$$

1) Calculating the ratio of  $BG$  and  $GE$ ,

$$\mathbf{G} - \mathbf{B} = \begin{pmatrix} 2 \\ -6 \end{pmatrix} \quad (4)$$

$$\mathbf{E} - \mathbf{G} = \begin{pmatrix} 1 \\ 3 \end{pmatrix} \quad (5)$$

$$\|\mathbf{G} - \mathbf{B}\| = \sqrt{2^2 + (-6)^2} = \sqrt{40} \quad (6)$$

$$\|\mathbf{E} - \mathbf{G}\| = \sqrt{1^2 + 3^2} = \sqrt{10} \quad (7)$$

$$\frac{BG}{GE} = \frac{\|\mathbf{G} - \mathbf{B}\|}{\|\mathbf{E} - \mathbf{G}\|} = \frac{\sqrt{40}}{\sqrt{10}} = 2 \quad (8)$$

2) Calculating the ratio of  $GF$  and  $CG$ ,

$$\mathbf{F} - \mathbf{G} = \begin{pmatrix} \frac{1}{2} \\ \frac{5}{2} \end{pmatrix} \quad (9)$$

$$\mathbf{G} - \mathbf{C} = \begin{pmatrix} 1 \\ 5 \end{pmatrix} \quad (10)$$

$$\|\mathbf{F} - \mathbf{G}\| = \sqrt{\left(\frac{1}{2}\right)^2 + \left(\frac{5}{2}\right)^2} = \frac{\sqrt{26}}{2} \quad (11)$$

$$\|\mathbf{G} - \mathbf{C}\| = \sqrt{1^2 + 5^2} = \sqrt{26} \quad (12)$$

$$\frac{CG}{GF} = \frac{\|\mathbf{G} - \mathbf{C}\|}{\|\mathbf{F} - \mathbf{G}\|} = \frac{\sqrt{26}}{\frac{\sqrt{26}}{2}} = 2 \quad (13)$$

3) Calculating the ratio of  $AG$  and  $GD$ ,

$$\mathbf{G} - \mathbf{A} = \begin{pmatrix} -3 \\ 1 \end{pmatrix} \quad (14)$$

$$\mathbf{D} - \mathbf{G} = \begin{pmatrix} -3 \\ 1 \\ 2 \end{pmatrix} \quad (15)$$

$$\|\mathbf{G} - \mathbf{A}\| = \sqrt{(-3)^2 + 1^2} = \sqrt{10} \quad (16)$$

$$\|\mathbf{D} - \mathbf{G}\| = \sqrt{\left(\frac{-3}{2}\right)^2 + \left(\frac{1}{2}\right)^2} = \frac{\sqrt{10}}{2} \quad (17)$$

$$\frac{AG}{GD} = \frac{\|\mathbf{G} - \mathbf{A}\|}{\|\mathbf{D} - \mathbf{G}\|} = \frac{\sqrt{10}}{\frac{\sqrt{10}}{2}} = 2 \quad (18)$$

From (8), (13), (18)

$$\frac{BG}{GE} = \frac{CG}{GF} = \frac{AG}{GD} = 2 \quad (19)$$

Hence verified.