

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).

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

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

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

1) Taking direction vector of BG and GE

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

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

2) Taking direction vector of GF and CG

$$\mathbf{F} - \mathbf{G} = \begin{pmatrix} \frac{1}{2} \\ \frac{3}{2} \\ 2 \end{pmatrix} \quad (7)$$

$$\mathbf{G} - \mathbf{C} = \begin{pmatrix} 1 \\ 5 \end{pmatrix} \quad (8)$$

3) Taking direction vector of AG and GD

$$\mathbf{G} - \mathbf{A} = \begin{pmatrix} -3 \\ 1 \end{pmatrix} \quad (10)$$

$$\mathbf{D} - \mathbf{G} = \begin{pmatrix} -3 \\ \frac{1}{2} \\ 2 \end{pmatrix} \quad (11)$$

Using the equation,

1) Taking the norm of BG and GE , from (4) and (5),

$$\|\mathbf{G} - \mathbf{B}\| = \sqrt{2^2 + (-6)^2} = \sqrt{40} \quad (12)$$

$$\|\mathbf{E} - \mathbf{G}\| = \sqrt{1^2 + 3^2} = \sqrt{10} \quad (13)$$

2) Taking the norm of GF and CG , from (7) and (8),

$$\|\mathbf{F} - \mathbf{G}\| = \sqrt{\left(\frac{1}{2}\right)^2 + \left(\frac{3}{2}\right)^2 + 2^2} = \frac{\sqrt{26}}{2} \quad (15)$$

$$\|\mathbf{G} - \mathbf{C}\| = \sqrt{1^2 + 5^2} = \sqrt{26} \quad (16)$$

3) Taking the norm of AG and GD , from (10) and (11)

$$\|\mathbf{G} - \mathbf{A}\| = \sqrt{(-3)^2 + 1^2} = \sqrt{10} \quad (18)$$

$$\|\mathbf{D} - \mathbf{G}\| = \sqrt{\left(-3\right)^2 + \left(\frac{1}{2}\right)^2 + 2^2} = \frac{\sqrt{10}}{2} \quad (19)$$

Now,

(6) 1) from equation (12) and (13),

$$\frac{BG}{GE} = \frac{\|\mathbf{G} - \mathbf{B}\|}{\|\mathbf{E} - \mathbf{G}\|} = \frac{\sqrt{40}}{\sqrt{10}} = 2 \quad (20)$$

(7) 2) from equation (15) and (16),

$$\frac{CG}{GF} = \frac{\|\mathbf{G} - \mathbf{C}\|}{\|\mathbf{F} - \mathbf{G}\|} = \frac{\sqrt{26}}{\frac{\sqrt{26}}{2}} = 2 \quad (21)$$

(9) 3) from equation (18) and (19),

$$\frac{AG}{GD} = \frac{\|\mathbf{G} - \mathbf{A}\|}{\|\mathbf{D} - \mathbf{G}\|} = \frac{\sqrt{10}}{\frac{\sqrt{10}}{2}} = 2 \quad (22)$$

Hence,

$$\frac{BG}{GE} = \frac{CG}{GF} = \frac{AG}{GD} = 2 \quad (23)$$