

Probability and Random Processes

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Q) Verify that

$$\frac{BG}{GE} = \frac{CG}{GF} = \frac{AG}{GD} = 2$$

Solution: Three vertices of the triangle and midpoints are:

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

$$\mathbf{C} = \begin{pmatrix} -3 \\ -5 \end{pmatrix}, \quad \mathbf{D} = \begin{pmatrix} -3.5 \\ 0.5 \end{pmatrix} \quad (2)$$

$$\mathbf{E} = \begin{pmatrix} -1 \\ -3 \end{pmatrix}, \quad \mathbf{F} = \begin{pmatrix} -1.5 \\ 2.5 \end{pmatrix} \quad (3)$$

$$\mathbf{G} = \begin{pmatrix} -2 \\ 0 \end{pmatrix} \quad (4)$$

1) Calculate AG:

$$AG = \|\mathbf{G} - \mathbf{A}\| \quad (5)$$

$$= \left\| \begin{pmatrix} -2 \\ 0 \end{pmatrix} - \begin{pmatrix} 1 \\ -1 \end{pmatrix} \right\| \quad (6)$$

$$= \left\| \begin{pmatrix} -3 \\ 1 \end{pmatrix} \right\| = \sqrt{10} \quad (7)$$

2) Calculate GD:

$$GD = \|\mathbf{D} - \mathbf{G}\| \quad (8)$$

$$= \left\| \begin{pmatrix} -3.5 \\ 0.5 \end{pmatrix} - \begin{pmatrix} -2 \\ 0 \end{pmatrix} \right\| \quad (9)$$

$$= \left\| \begin{pmatrix} -1.5 \\ 0.5 \end{pmatrix} \right\| = \sqrt{2.5} \quad (10)$$

3) The ratio of AG : GD = $\frac{\sqrt{10}}{\sqrt{2.5}} = 2:1$

4) Calculate BG:

$$BG = \|\mathbf{G} - \mathbf{B}\| \quad (11)$$

$$= \left\| \begin{pmatrix} -2 \\ 0 \end{pmatrix} - \begin{pmatrix} -4 \\ 6 \end{pmatrix} \right\| \quad (12)$$

$$= \left\| \begin{pmatrix} 2 \\ -6 \end{pmatrix} \right\| = \sqrt{40} \quad (13)$$

$$(14)$$

5) Calculate GE:

$$GE = \|\mathbf{E} - \mathbf{G}\| \quad (15)$$

$$= \left\| \begin{pmatrix} -1 \\ -3 \end{pmatrix} - \begin{pmatrix} -2 \\ 0 \end{pmatrix} \right\| \quad (16)$$

$$= \left\| \begin{pmatrix} 1 \\ -3 \end{pmatrix} \right\| = \sqrt{10} \quad (17)$$

6) The ratio of BG : GE = $\frac{\sqrt{40}}{\sqrt{10}} = 2:1$

7) Calculate CG:

$$CG = \|\mathbf{G} - \mathbf{C}\| \quad (18)$$

$$= \left\| \begin{pmatrix} -2 \\ 0 \end{pmatrix} - \begin{pmatrix} -3 \\ -5 \end{pmatrix} \right\| \quad (19)$$

$$= \left\| \begin{pmatrix} 1 \\ 5 \end{pmatrix} \right\| = \sqrt{26} \quad (20)$$

$$(21)$$

8) Calculate GF:

$$GF = \|\mathbf{F} - \mathbf{G}\| \quad (22)$$

$$= \left\| \begin{pmatrix} -1.5 \\ 2.5 \end{pmatrix} - \begin{pmatrix} -2 \\ 0 \end{pmatrix} \right\| \quad (23)$$

$$= \left\| \begin{pmatrix} 0.5 \\ 2.5 \end{pmatrix} \right\| = \sqrt{6.5} \quad (24)$$

9) The ratio of CG : GF = $\frac{\sqrt{26}}{\sqrt{6.5}} = 2:1$

10) Therefore $\frac{BG}{GE} = \frac{CG}{GF} = \frac{AG}{GD} = 2$