



# **GENERAL MATHEMATICS 2024**

## **Unit 4**

### **Key Topic Test 3 – Transition Matrices**

Recommended writing time\*: 45 minutes

Total number of marks available: 25 marks

## **SOLUTIONS**

**SECTION A – Multiple Choice (1 mark per question)**

**Question 1**

*Answer:* C

$$\begin{matrix} & \text{from} \\ & A & B \\ \text{to} & \begin{bmatrix} 0.9 & 0.15 \\ 0.1 & 0.85 \end{bmatrix} \end{matrix}$$

**Question 2**

*Answer:* B

$$\begin{bmatrix} 0.9 & 0.15 \\ 0.1 & 0.85 \end{bmatrix}^3 \begin{bmatrix} 100 \\ 100 \end{bmatrix} = \begin{bmatrix} 111.56 \\ 88.44 \end{bmatrix}$$

**Question 3**

*Answer:* E

$$100 - (25 + 9) = 66\%$$

**Question 4**

*Answer:* A

$$\begin{bmatrix} 0.72 & 0.14 & 0.25 \\ 0.18 & 0.68 & 0.09 \\ 0.1 & 0.18 & 0.66 \end{bmatrix}^2 \begin{bmatrix} 100 \\ 100 \\ 100 \end{bmatrix} = \begin{bmatrix} 116.72 \\ 93.04 \\ 90.24 \end{bmatrix}$$

$$B = 93$$

**Question 5**

*Answer:* E

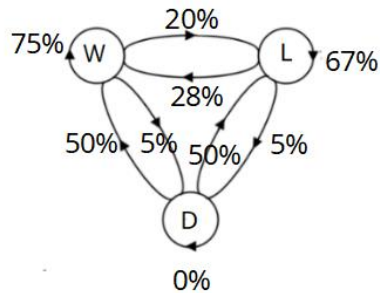
$$\begin{bmatrix} 0.72 & 0.14 & 0.25 \\ 0.18 & 0.68 & 0.09 \\ 0.1 & 0.18 & 0.66 \end{bmatrix}^{\infty} \begin{bmatrix} 100 \\ 100 \\ 100 \end{bmatrix} \approx \begin{bmatrix} 122 \\ 93 \\ 85 \end{bmatrix}$$

$$C = 85 \text{ scooters}$$

**SECTION B – Short Answer**

**Question 1**

**a.**



2 marks

**b.**

$$T = \begin{array}{c} \text{This round} \\ \begin{array}{ccc} W & L & D \\ \begin{bmatrix} 0.75 & 0.28 & 0.5 \\ 0.20 & 0.67 & 0.5 \\ 0.05 & 0.05 & 0 \end{bmatrix} \end{array} \begin{array}{l} W \\ L \\ D \end{array} \text{ next round} \end{array}$$

2 marks

**c.**  $S_0 = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} \begin{array}{l} W \\ L \\ D \end{array}$

1 mark

**d.**  $S_1 = TS_0 = \begin{bmatrix} 0.75 \\ 0.2 \\ 0.05 \end{bmatrix}$

Win = 75%  
Lose = 20%  
Draw = 5%

2 marks

**e.**  $S_3 = T^3 S_0$   
 $= \begin{bmatrix} 0.59 \\ 0.36 \\ 0.05 \end{bmatrix}$

Winning = 59%

2 marks

**f.** 75% of 4 = 3 teams

1 mark

**Question 2**

$$\begin{aligned}\text{a. } m &= 100 - 60 - 5 = 35\% \\ n &= 100 - 70 - 15 = 15\% \\ p &= 100 - 75 - 20 = 5\%\end{aligned}$$

2 marks

$$\begin{aligned}\text{b. } S_1 &= \begin{bmatrix} 0.75 & 0.15 & 0.35 \\ 0.20 & 0.70 & 0.05 \\ 0.05 & 0.15 & 0.60 \end{bmatrix} S_0 \\ &= \begin{bmatrix} 41 \\ 19.75 \\ 19.25 \end{bmatrix}\end{aligned}$$

Yoga = 41 members

2 marks

$$\begin{aligned}\text{c. } 0.75 \times 40 + 0.70 \times 15 + 0.60 \times 25 \\ = 55.5 \\ \approx 56 \text{ members}\end{aligned}$$

2 marks

$$\text{d. } S_{20} = S_{21} \approx \begin{bmatrix} 37.5 \\ 27.5 \\ 15 \end{bmatrix}$$

37 in Yoga, 28 in Boxing and 15 in Cardio

2 marks

$$\text{e. } \begin{bmatrix} 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 3 \\ 1 \\ -2 \end{bmatrix} = 2$$

Net effect, 2 members are added each week

1 mark

$$\begin{aligned}\text{f. } S_2 &= \begin{bmatrix} 0.8 & 0.2 & 0.05 \\ 0.1 & 0.5 & 0.3 \\ 0.1 & 0.3 & 0.65 \end{bmatrix} \begin{bmatrix} 50 \\ 30 \\ 20 \end{bmatrix} + \begin{bmatrix} 3 \\ 1 \\ -2 \end{bmatrix} \\ &= \begin{bmatrix} 50 \\ 27 \\ 25 \end{bmatrix}\end{aligned}$$

1 mark

**END OF KEY TOPIC TEST SOLUTIONS**