GENERAL MATHEMATICS 2024

37/0

Unit 4
Key Topic Test 4 – Leslie 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: D

$L_{32} = 0.6$

Question 2
Answer: A

$$L^2 \times S_0 = \begin{bmatrix} 172 \\ 72 \\ 48 \end{bmatrix} \begin{matrix} 1 \\ 2 \\ 3 \end{matrix}$$

Question 3
Answer: D

$a =$ birth rate $1 - 2 = 0.3$

$b =$ birth rate $2 - 3 = 0.1$

$c =$ survival rate $0 - 1 = 0.5$

$d =$ survival rate $1 - 2 = 0.8$

Question 4
Answer: E

$$L^3 \times S_0 = \begin{bmatrix} 68.8 \\ 41.5 \\ 40 \end{bmatrix} \begin{matrix} 0-1 \\ 1-2 \\ 2-3 \end{matrix}$$

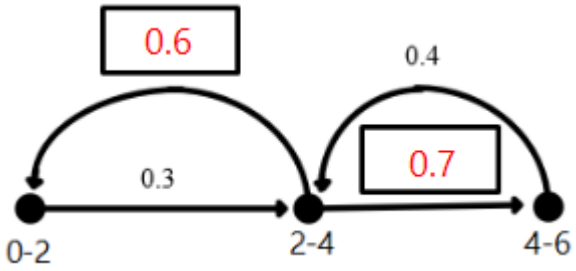
Question 5
Answer: C

$$S_0 = L^{-1} \times S_1$$
$$= \begin{bmatrix} 50 \\ 20 \\ 10 \end{bmatrix}$$

SECTION B – Short Answer

Question 1

a.



2 marks

b. $S_0 = \begin{bmatrix} 50 \\ 220 \\ 30 \end{bmatrix} \begin{matrix} 0-2 \\ 2-4 \\ 4-6 \end{matrix}$

1 mark

c. $S_3 = L^3 \times S_0$

$= \begin{bmatrix} 30.12 \\ 21.18 \\ 30.24 \end{bmatrix} \begin{matrix} 0-2 \\ 2-4 \\ 4-6 \end{matrix}$

Number aged 2-4 $= 21.18 \approx 21$ birds

2 marks

d. $\begin{bmatrix} 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 30.12 \\ 21.18 \\ 30.24 \end{bmatrix} = [81.54]$

$\frac{30.12}{81.54} \times 100 \approx 37\%$

2 marks

e. $S_{10} = \begin{bmatrix} 0.75 \\ 0.40 \\ 0.46 \end{bmatrix}$

$S_{11} = \begin{bmatrix} 0.43 \\ 0.22 \\ 0.28 \end{bmatrix}$ This rounds to 0 population

$S_{11} = 22$ years

2 marks

Question 2

a. $L_{12} = 0.5$

1 mark

b. $L_{21} = 0.8$

1 mark

c. $[1 \quad 1 \quad 1]\begin{bmatrix}250\\208\\110\end{bmatrix} = [568]$

Initial population = 568

1 mark

d. $S_1 = \begin{bmatrix}148\\200\\124.8\end{bmatrix}$

Total $S_1 = 472.8$

$568 - 472.8 = 95.2$
$\frac{95.2}{568} \times 100 \approx 17\%$

2 marks

e. $S_5 = L^5 \times S_0$

$= \begin{bmatrix}71.66\\70.71\\51.46\end{bmatrix}$

Population age group $2 \approx 71$

2 marks

Question 3

a. $S_{54} = \begin{bmatrix}475834799\\144083187\\65442769\end{bmatrix}, \quad S_{55} = \begin{bmatrix}628577869\\190333920\\86449912\end{bmatrix}$

2 marks

b. $\frac{628577869}{475834799} = \frac{190333920}{144083187} = \frac{86449912}{65442769} \approx 1.3$

1 mark

c. After 54 cycles, the population growth has steadied to a rate of 1.3 (increase of 30% each cycle).

1 mark

END OF KEY TOPIC TEST SOLUTIONS