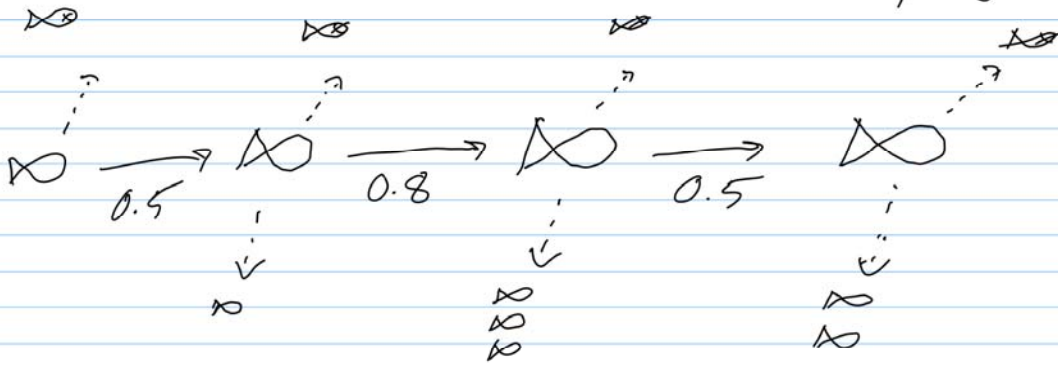


Lecture 3: Structure

Leslie matrix \rightarrow age-structure

mortality
fecundity \rightarrow example of a projection matrix



Age	Survival	Fecundity
0	0.5	0
1	0.8	1
2	0.5	3
3	0	2

vector

$$\begin{pmatrix} 20 \\ 30 \\ 8 \end{pmatrix}$$

scalar

0.5

scalar \times vector

$$0.5 \begin{pmatrix} 20 \\ 30 \\ 8 \end{pmatrix} = \begin{pmatrix} 10 \\ 15 \\ 4 \end{pmatrix} = v$$

matrix

$$\begin{pmatrix} 0.1 & 0.2 & 0.3 \\ 0.5 & 0.7 & 0.3 \\ 0.1 & 0.3 & 0.8 \end{pmatrix} = M$$

$$\begin{pmatrix} a & b & c \\ d & e & f \\ g & h & i \end{pmatrix} \xrightarrow{\text{transpose}} \begin{pmatrix} a & d & g \\ b & e & h \\ c & f & i \end{pmatrix}$$

matrix multiplication \rightarrow dot product
 \rightarrow inner product

$$\begin{pmatrix} a & b & c \\ d & e & f \\ g & h & i \end{pmatrix} \cdot \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} ax + by + cz \\ dx + ey + fz \\ gx + hy + iz \end{pmatrix}$$

$$\begin{pmatrix} x & y & z \\ a & + & b & + & c \end{pmatrix} \rightarrow$$

\downarrow
is a vector

$$I = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 74 \\ 93 \\ 5 \end{pmatrix} = \begin{pmatrix} 74 \times 1 + 93 \times 0 + 5 \times 0 \\ 74 \times 0 + 93 \times 1 + 5 \times 0 \\ 0 + 0 + 5 \times 1 \end{pmatrix}$$

Leslie matrix

$$\begin{pmatrix} F_0 & F_1 & F_2 \\ P_0 & 0 & 0 \\ 0 & P_1 & 0 \end{pmatrix}$$

where

F_x = fecundity of age x

P_x = survival at age x

$$\downarrow$$

$$\begin{pmatrix} 74 \\ 93 \\ 5 \end{pmatrix}$$

next age: \leftarrow

current age: \leftarrow

$$\begin{pmatrix} F_0 & F_1 & F_2 \\ P_0 & 0 & 0 \\ 0 & P_1 & 0 \end{pmatrix}$$

Make the Leslie matrix for our fish population

$$\begin{pmatrix} 0 & 1 & 3 & 2 \\ 0.5 & 0 & 0 & 0 \\ 0 & 0.8 & 0 & 0 \\ 0 & 0 & 0.5 & 0 \end{pmatrix}$$

Lifetime Reproductive Success or Net Reproductive Rate

<u>Age</u>	<u>Survival</u>	<u>Survivorship</u>	<u>Fecundity</u>	
0	0.5	1	0	$1 \times 0 = 0$
1	0.8	0.5	1	$0.5 \times 1 = 0.5$
2	0.5	0.4	3	$0.4 \times 3 = 1.2$
3	0	0.2	2	$0.2 \times 2 = 0.4$
		0		

$$R_0 = \underline{\underline{2.1}}$$

↓
per
generation

$$\lambda = 1.29$$

↓
per year