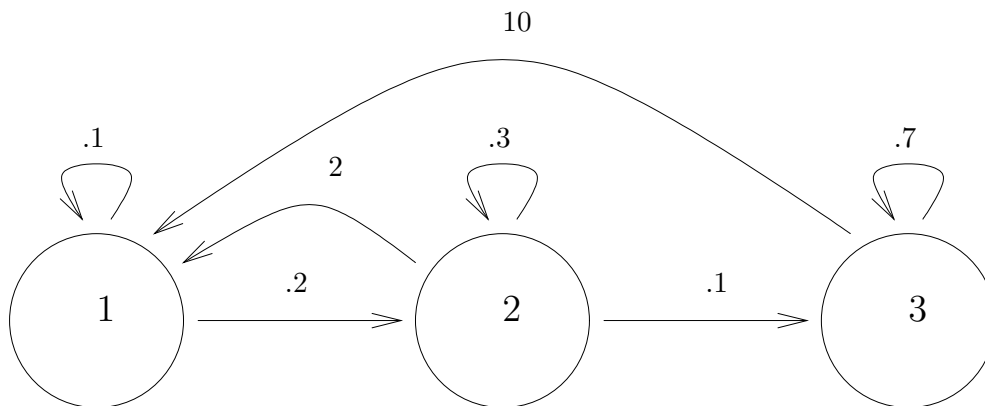


## Mathematics 172 Homework.

A plant has 3 stages in its life history. It can be

- (1) A seed,
- (2) A juveniles that only produce a few seeds,
- (3) An adult which produces more seeds.

The life history is summarized by the following loop diagram.



1. What is the average number of female seeds produced by an adult?

*Answer:* 10.

2. What proportion of juveniles stay juvenile for another year? *Answer:* .3

3. What proportion of juveniles become adults the next year? *Answer:* .1

4. What proportion of die in a given year? *Answer:*  $1 - .3 - .1 = .6$

5. What is the Leslie Matrix? *Answer:*  $A = \begin{bmatrix} .1 & 2 & 10 \\ .2 & .3 & 0 \\ 0 & .1 & .7 \end{bmatrix}$ .

6. Based on an initial population distribution of

$$\mathbf{n}(0) = \begin{bmatrix} 10 \\ 2 \\ 1 \end{bmatrix}$$

compute  $\mathbf{n}(30)$  and  $\mathbf{n}(31)$ . *Answer:*

$$\mathbf{n}(30) = \begin{bmatrix} 529.3766 \\ 127.02818 \\ 29.3043 \end{bmatrix}, \quad \mathbf{n}(31) = \begin{bmatrix} 600.03740 \\ 143.9837 \\ 33.2158 \end{bmatrix}$$

7. To find the growth rate we look to find  $\lambda$  with

$$\mathbf{n}(31) = \lambda \mathbf{n}(30)$$

that is

$$\begin{bmatrix} 600.03740 \\ 143.9837 \\ 33.2158 \end{bmatrix} = \begin{bmatrix} 529.3766\lambda \\ 127.02818\lambda \\ 29.3043\lambda \end{bmatrix}$$

This leads to three equations for  $\lambda$

$$529.3766\lambda = 600.03740$$

$$127.02818\lambda = 143.9837$$

$$29.3043\lambda = 33.2158$$

Solve these for  $\lambda$  and compare the results. *Answer:*

$$\lambda = \frac{600.03740}{529.3766} = 1.1335,$$

$$\lambda = \frac{143.9837}{127.02818} = 1.13354,$$

$$\lambda = \frac{33.2158}{29.3043} = 1.13348$$

So, accurate to 4 decimal places,  $\lambda = 1.1335$ . Thus the per capita growth rate is

$$r = \lambda - 1 = .1335$$

**8.** Finally find the stable age distribution. *Answer:* I used the numbers from  $\mathbf{n}(30)$  and got

Proportion of population that is seeds =  $.7720 = 77.20\%$

Proportion of population that is juvenile =  $.1852 = 18.52\%$

Proportion of population that is adult =  $.04273 = 4.273\%$