Mathematics 172

Quiz 19 Name: Key

You must show your work to get full credit.

For the Leslie matrix

$$L = \begin{bmatrix} f_1 & f_2 & f_3 \\ p_1 & 0 & 0 \\ 0 & p_2 & 0 \end{bmatrix}$$

the Euler-Lotka equation is

$$\frac{f_1}{\lambda} + \frac{p_1 f_2}{\lambda^2} + \frac{p_1 p_2 f_3}{\lambda^3} = 1.$$

and if we set

$$n_1 = 1 \qquad n_2 = \frac{p_1}{\lambda} \qquad n_3 = \frac{p_1 p_2}{\lambda^2}, \qquad N = n_1 + n_2 + n_3$$

then the stable age distribution is given by the vector

$$\frac{1}{N}\begin{bmatrix} n_1 \\ n_2 \\ n_3 \end{bmatrix}$$

For the Leslie matrix

$$L = \begin{bmatrix} 0 & 1.5 & 16.5 \\ .1 & 0 & 0 \\ 0 & .65 & 0 \end{bmatrix}$$

1. What are the growth ratio, λ, and per capita growth rate, r.

$\lambda =$ 1.0724 $\qquad r =$ .0724

The Euler-Lotka equation is

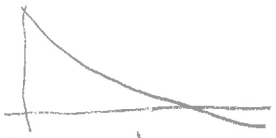
$\frac{0}{\lambda} + \frac{.1(1.5)}{\lambda^2} + \frac{(.1)(.65)(16.5)}{\lambda^3} = 1$

$Y_1 = .1(1.5)/X^2 + (.1)(.65)(16.5)/X^3 - 1$

$X_{min} = .5$

$X_{max} = 1.5$

ZoomFit



2nd CALC 2:Zero to get

$\lambda = X = 1.0724$

$r = \lambda - 1 = .0724$

2. What is the stable age distribution?

Proportion in stage 1 .8698

Proportion in stage 2 .0815

Proportion in stage 3 .0519

$n_1 = 1$

$n_2 = \frac{.1}{1.0720} = .0932$

$n_3 = \frac{.1(.65)}{(1.0720)^2} = .0565$

$N = 1 + .0923 + .0565$

$= 1.1497$

$$\frac{1}{N}\begin{bmatrix} n_1 \\ n_2 \\ n_3 \end{bmatrix} = \frac{1}{1.1497}\begin{bmatrix} 1 \\ .0937 \\ .0567 \end{bmatrix} = \begin{bmatrix} .8698 \\ .0815 \\ .0519 \end{bmatrix}$$