**Solutions to Exercise 3**

Q1 Leslie Matrix is $L = \begin{bmatrix} \frac{1}{3} & 4 \\ \frac{2}{3} & 0 \end{bmatrix}$, $\lambda_{max} = 1.81$ so population will grow. Stable age distribution is $\begin{bmatrix} 1 \\ 0.37 \end{bmatrix}$ or $\begin{bmatrix} 0.73 \\ 0.27 \end{bmatrix}$

Q2 Leslie Matrix is $L = \begin{bmatrix} 1 & 2 \\ 0.5 & 0 \end{bmatrix}$, $\lambda_{max} = 1.618$ so population will grow. Stable age distribution is $\begin{bmatrix} 1 \\ 0.3 \end{bmatrix}$ or $\begin{bmatrix} 0.77 \\ 0.23 \end{bmatrix}$

Q4 For $L = \begin{bmatrix} 0 & 7 & 6 \\ \frac{1}{4} & 0 & 0 \\ 0 & \frac{1}{2} & 0 \end{bmatrix}$ the characteristic equation is given by $\lambda^3 - \frac{11}{8}\lambda + \frac{3}{4} = 0$ so inserting $\lambda = \frac{3}{2}$ gives $\frac{27}{8} - \frac{33}{16} + \frac{3}{4}$ which equates to zero, verifying that $\lambda_{max} = \frac{3}{2}$ is a root. Stable age distribution is given by $\begin{bmatrix} 18 \\ 3 \\ 1 \end{bmatrix}$

Q5 For $L = \begin{bmatrix} 0 & 2.5 & 2.5 \\ \frac{1}{3} & 0 & 0 \\ 0 & \frac{1}{4} & 0 \end{bmatrix}$ the characteristic equation is given by $\lambda^3 - \frac{5}{6}\lambda - \frac{5}{24} = 0$. We can solve this by Newton Raphson to give inserting $\lambda_{max} = 1.02$. Stable age distribution is given by $\begin{bmatrix} 1 \\ 0.245 \\ 0.08 \end{bmatrix}$