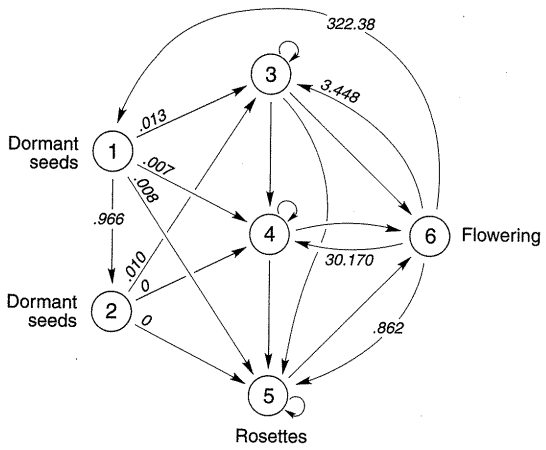
Examining Caswell's teasel model

Common teasel *Dipsacus sylvestris* was introduced to North America in the 18th century so its dried seed heads could be used in wool processing. It has since become a weed that colonizes disturbed habitats such as roadsides and newly cleared land. Here is a life history graph for a teasel model from Caswell's book (Caswell, 2002).



Classes 3, 4 and 5 represent small medium and large rosettes respectively. There are no seeds included as a life stage in this graph. Seeds either germinate in the first season they are produced and become rosettes or they turn into dormant seeds. The missing values of coefficients on the life history graph are:

$$\begin{array}{lllllllll} a_{33} & = & 0.125 & a_{53} & = & 0.036 & a_{63} & = & 0 \\ a_{43} & = & 0.125 & a_{54} & = & 0.245 & a_{64} & = & 0.023 \\ a_{44} & = & 0.238 & a_{55} & = & 0.167 & a_{65} & = & 0.750. \end{array}$$

Include these in your transition matrix $\mathbf{A}$. Using Matlab, find all the eigenvalues of $\mathbf{A}$.

Can you identify an eigenvalue which is positive, real and greater in magnitude than any other eigenvalue? Does this eigenvalue have a corresponding eigenvector that is strictly positive? If so, find the stable age distribution of the population and interpret your results. If not, can you interpret your results to make predictions of how the teasel population will behave over time?

In some parts of the USA teasel is actively controlled by local authorities to prevent it crowding out native vegetation. Which of the following strategies are likely to be more effective?

1. Spraying the rosettes with herbicide so that the contribution to other classes by each of the three rosette classes is reduced by half.

2. Slashing the heads of the flowering to reduce seed set. This reduces the contribution of the flowering plants class to other classes by two thirds.

Give reasons for your answer.