4. We have a successional model of dunes, grasses, shrubs and trees, with matrix. Time is measured in decades.
   a. If the current situation is 100% dunes, what is the distribution in two decades?
   b. The dominant eigenvector for this matrix is $\mathbf{v} = \begin{bmatrix} 0.075 \\ 0.121 \\ 0.161 \\ 0.643 \end{bmatrix}$. What information does this vector give you? Is there a climax species, that is, one that dominates the habitat in the long term?
   c. Is this a model of facilitation, inhibition, or tolerance?

$$\begin{bmatrix} 0.2 & 0.1 & 0.1 & 0.05 \\ 0.8 & 0.5 & 0.0 & 0.0 \\ 0.0 & 0.4 & 0.7 & 0.0 \\ 0.0 & 0.0 & 0.2 & 0.95 \end{bmatrix}$$

5. A different successional model for species A, B, C, D has matrix

$$\begin{bmatrix} 0.2 & 0.1 & 0.1 & 0.1 \\ 0.7 & 0.3 & 0.1 & 0.1 \\ 0.1 & 0.3 & 0.4 & 0.3 \\ 0.1 & 0.3 & 0.4 & 0.5 \end{bmatrix}$$

   a. If the current situation is 100% C, what is the distribution in two decades?
   b. The dominant eigenvector for this matrix is $\mathbf{v} = \begin{bmatrix} 0.111 \\ 0.208 \\ 0.309 \\ 0.372 \end{bmatrix}$. What information does this vector give you? Is there a climax species, that is, one that dominates the habitat in the long term?
   c. Is this a model of facilitation, inhibition, or tolerance?

6. A metapopulation has a patch to patch colonization rate of 15% and a local extinction rate of 7.5%; that is $\frac{dp}{dt} = 0.15p(1-p) - 0.075p$. Find the equilibrium value other than $p = 0$ for the percent of occupied patches. Use a graphical analysis to determine if this equilibrium is stable or not.