```
> restart : with(LinearAlgebra) : with(plots) : with(plottools) :
> #i)
>
```

> $P := Matrix\left(\left[[0, 0, 1, 0, 0], \left[\frac{1}{2}, 0, 0, 0, 0\right], \left[\frac{1}{2}, 1, 0, 0, 0\right], \left[0, 0, 0, \frac{1}{2}, 0\right], \left[0, 0, 0, \frac{1}{2}, 1\right]\right]\right)$

$$P := \begin{bmatrix} 0 & 0 & 1 & 0 & 0 \\ \frac{1}{2} & 0 & 0 & 0 & 0 \\ \frac{1}{2} & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & \frac{1}{2} & 0 \\ 0 & 0 & 0 & \frac{1}{2} & 1 \end{bmatrix} \quad \textbf{(1)}$$

> $T := \frac{1}{5} Matrix([[1, 1, 1, 1, 1], [1, 1, 1, 1, 1], [1, 1, 1, 1, 1], [1, 1, 1, 1, 1], [1, 1, 1, 1, 1]])$

$$T := \begin{bmatrix} \frac{1}{5} & \frac{1}{5} & \frac{1}{5} & \frac{1}{5} & \frac{1}{5} \\ \frac{1}{5} & \frac{1}{5} & \frac{1}{5} & \frac{1}{5} & \frac{1}{5} \\ \frac{1}{5} & \frac{1}{5} & \frac{1}{5} & \frac{1}{5} & \frac{1}{5} \\ \frac{1}{5} & \frac{1}{5} & \frac{1}{5} & \frac{1}{5} & \frac{1}{5} \\ \frac{1}{5} & \frac{1}{5} & \frac{1}{5} & \frac{1}{5} & \frac{1}{5} \end{bmatrix} \quad \textbf{(2)}$$

> $G := a \rightarrow a \cdot P + (1 - a) \cdot T$

$$G := a \mapsto a \cdot P + (1 - a) \cdot T \quad \textbf{(3)}$$

> #ii)

> $J, Q := JordanForm(G(a), output = ['J', 'Q'])$

(4)

$$J, Q := \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & a & 0 & 0 & 0 \\ 0 & 0 & \left(-\frac{1}{2} - \frac{\mathrm{I}}{2}\right) a & 0 & 0 \\ 0 & 0 & 0 & \left(-\frac{1}{2} + \frac{\mathrm{I}}{2}\right) a & 0 \\ 0 & 0 & 0 & 0 & \frac{a}{2} \end{bmatrix}, \left[\left[\frac{2\,(a^2 + a + 1)}{5\,(a^2 + 2\,a + 2)}, \frac{4}{25}, \right.\right. \quad (4)$$

$$\left.\frac{3\,\mathrm{I}\,a + 10 + 2\,\mathrm{I} + 5\,a}{10\,(2\,\mathrm{I}\,a + 3 + \mathrm{I} + a)}, \frac{-\frac{\mathrm{I}}{50}\,(11\,\mathrm{I}\,a^2 + 32\,\mathrm{I}\,a - 7\,a^2 - 4 + 32\,\mathrm{I} - 14\,a)}{a^2 + 2\,a + 2}, 0\right],$$

$$\left[\frac{a + 2}{5\,(a^2 + 2\,a + 2)}, \frac{2}{25}, \frac{\mathrm{I}\,a - 6 + 4\,\mathrm{I} - 4\,a}{10\,(2\,\mathrm{I}\,a + 3 + \mathrm{I} + a)}, \right.$$

$$\left.\frac{\frac{\mathrm{I}}{50}\,(2\,\mathrm{I}\,a^2 + 9\,\mathrm{I}\,a - 9\,a^2 - 18 + 14\,\mathrm{I} - 23\,a)}{a^2 + 2\,a + 2}, 0\right],$$

$$\left[\frac{a^2 + 3\,a + 2}{5\,(a^2 + 2\,a + 2)}, \frac{4}{25}, -\frac{4\,\mathrm{I}\,a + 4 + 6\,\mathrm{I} + a}{10\,(2\,\mathrm{I}\,a + 3 + \mathrm{I} + a)}, \right.$$

$$\left.\frac{\frac{\mathrm{I}}{50}\,(9\,\mathrm{I}\,a^2 + 23\,\mathrm{I}\,a + 2\,a^2 + 14 + 18\,\mathrm{I} + 9\,a)}{a^2 + 2\,a + 2}, 0\right],$$

$$\left[\frac{2\,(-1 + a)}{5\,(a - 2)}, 0, 0, 0, -\frac{2\,(-1 + a)}{5\,(a - 2)}\right],$$

$$\left.\left.\left[-\frac{2}{5\,(a - 2)}, -\frac{2}{5}, 0, 0, \frac{2\,(-1 + a)}{5\,(a - 2)}\right]\right]\right]$$

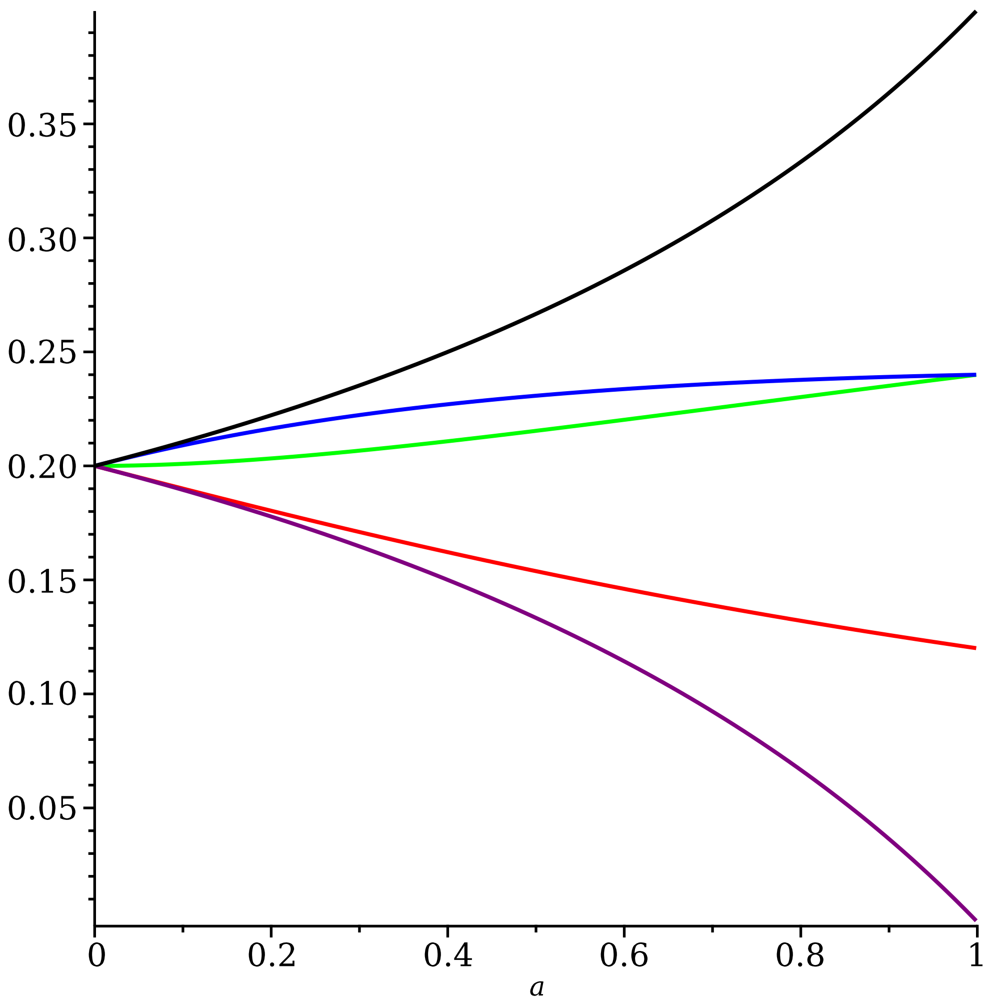
> *# Hier zien we alvast dat lambda 1 dominant is, dus eigenvector 1 is sexy*

> $sol := Q[\,..,\,1\,]$

(5)

$$sol := \begin{bmatrix} \frac{2\,(a^2+a+1)}{5\,(a^2+2\,a+2)} \\ \frac{a+2}{5\,(a^2+2\,a+2)} \\ \frac{a^2+3\,a+2}{5\,(a^2+2\,a+2)} \\ \frac{2\,(-1+a)}{5\,(a-2)} \\ -\frac{2}{5\,(a-2)} \end{bmatrix} \tag{5}$$

> $plot(sol, a = 0..1, color = [green, red, blue, purple, black]);$
> $evalf(subs(\{a = 1\}, sol));$



(6)

$$\begin{bmatrix} 0.2400000000 \\ 0.1200000000 \\ 0.2400000000 \\ 0. \\ 0.4000000000 \end{bmatrix} \tag{6}$$

> *# we zien dus dat website 5 het meest zal worden bezocht*

> *#iii)*

> $J, Q := JordanForm(G(1), output = ['J', 'Q'])$

$$J, Q := \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & \frac{1}{2} & 0 & 0 & 0 \\ 0 & 0 & -\frac{1}{2} - \frac{I}{2} & 0 & 0 \\ 0 & 0 & 0 & -\frac{1}{2} + \frac{I}{2} & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}, \tag{7}$$

$$\begin{bmatrix} \frac{2}{5} & 0 & \frac{3}{10} - \frac{I}{10} & \frac{3}{10} + \frac{I}{10} & -\frac{2}{5} \\ \frac{1}{5} & 0 & -\frac{1}{10} + \frac{I}{5} & -\frac{1}{10} - \frac{I}{5} & -\frac{1}{5} \\ \frac{2}{5} & 0 & -\frac{1}{5} - \frac{I}{10} & -\frac{1}{5} + \frac{I}{10} & -\frac{2}{5} \\ 0 & 1 & 0 & 0 & 0 \\ 1 & -1 & 0 & 0 & 0 \end{bmatrix}$$

> *# antwoord is dan ofcourse v_1 en v_5 letsgo*

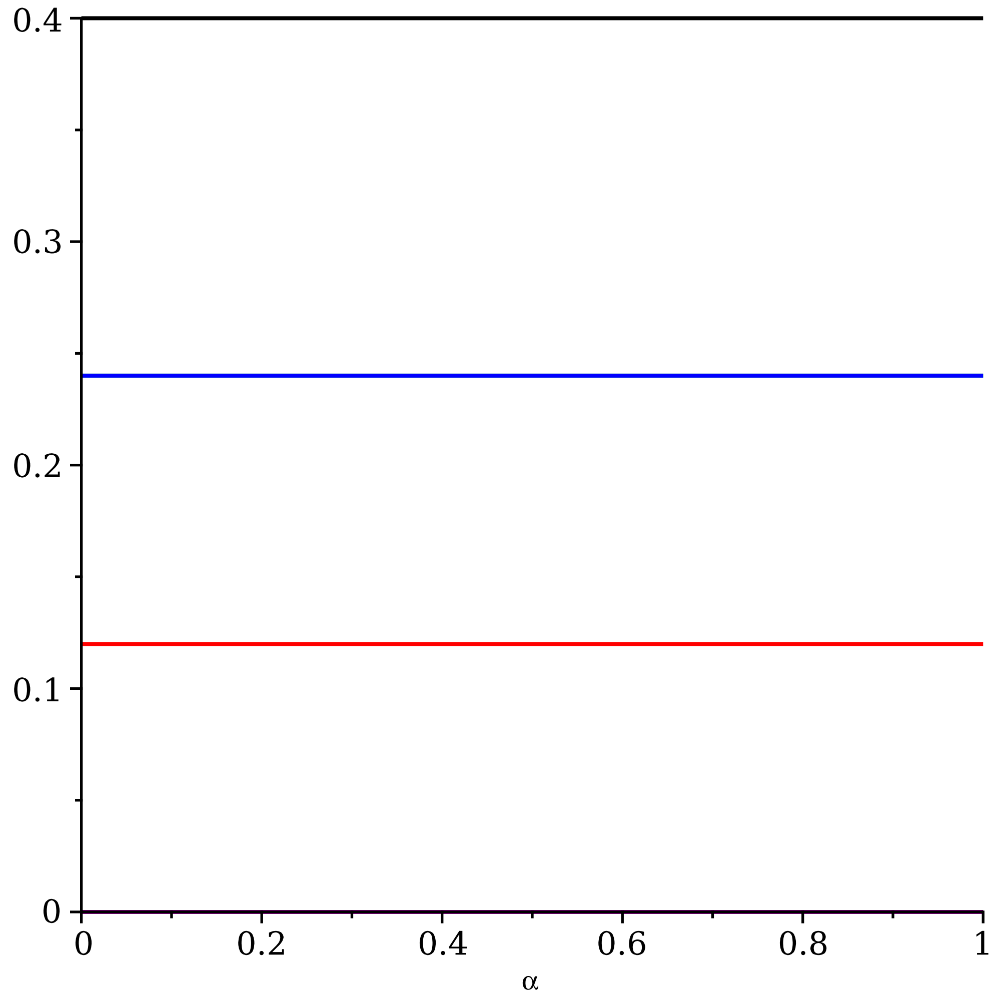
> *#iv)*

> $state\_n := (n, x0) \rightarrow Q \cdot J\hat{}\, n \cdot MatrixInverse(Q) \cdot x0 :$

> *# eerst uniform dus 0.2 prob per sprong*

> $x0 := \langle 0.2, 0.2, 0.2, 0.2, 0.2 \rangle;$
$state\_20 := state\_n(20, x0) :$
$plot1 := plot(state\_20, \alpha = 0..1, color = [green, red, blue, purple, black]);$

$$x0 := \begin{bmatrix} 0.2 \\ 0.2 \\ 0.2 \\ 0.2 \\ 0.2 \end{bmatrix}$$

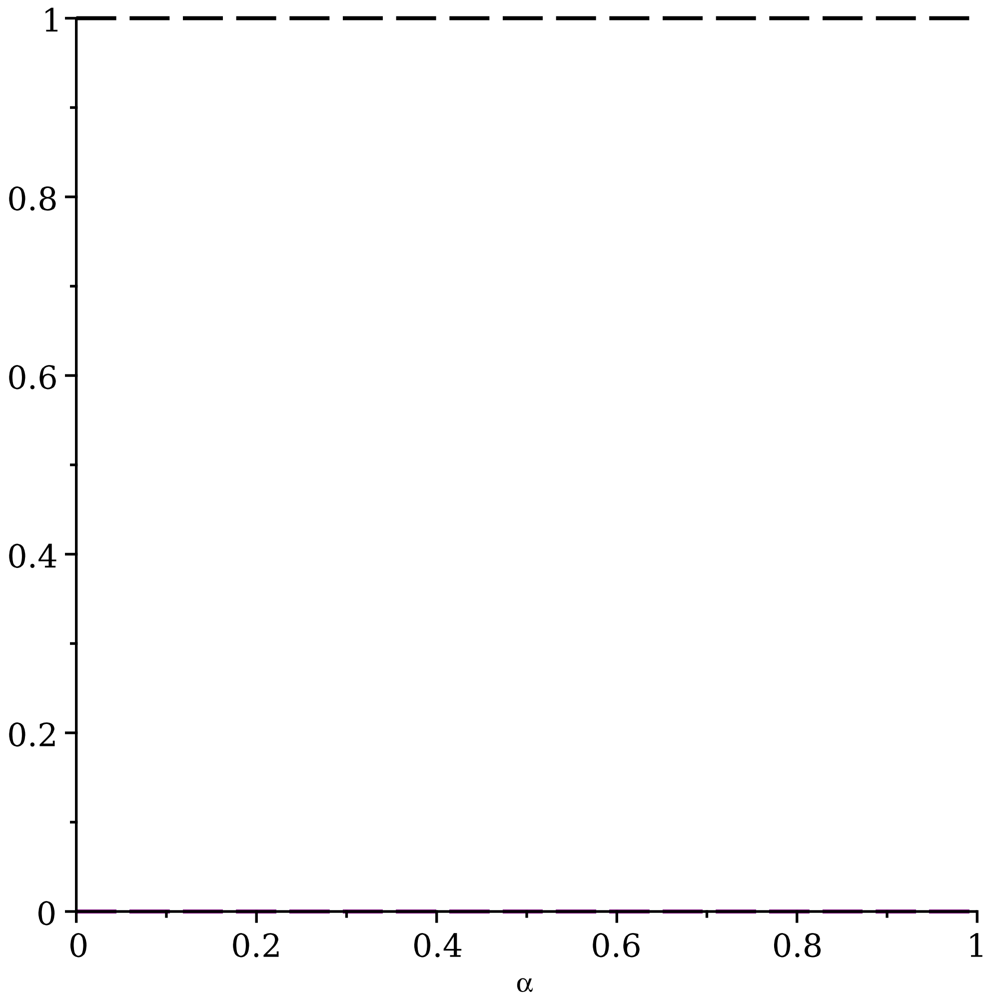


> # ik denk dat mijn Q en J niet goed zijn ingeladen, anyways I dont care

> # Nu kijken naar bezetting van website 4 en 5, dus 50 50

```
> x0 := ⟨0, 0, 0, 0.5, 0.5⟩;
  state_50 := state_n(20, x0) :
  plot2 := plot(state_50, alpha = 0 ..1, color = [green, red, blue, purple, black],
      linestyle = "dash");
```

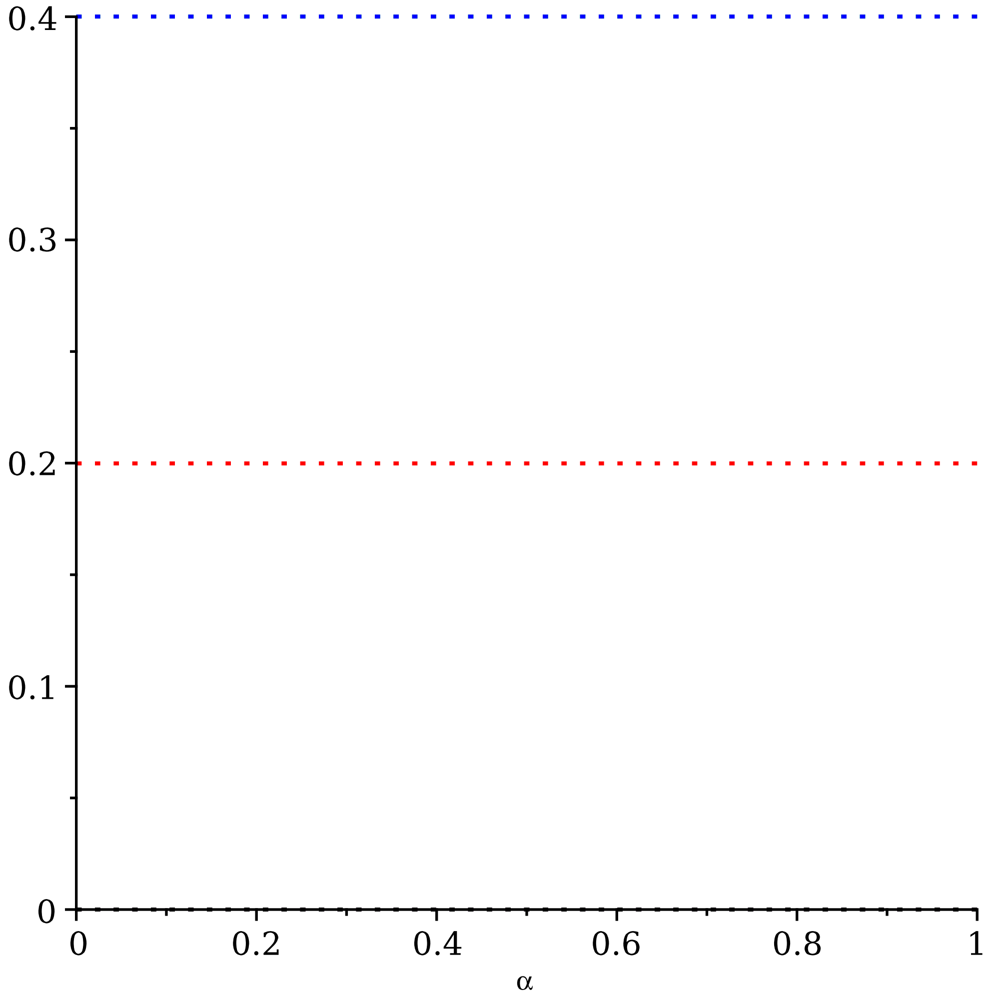
$$x0 := \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0.5 \\ 0.5 \end{bmatrix}$$



> *# Als laatste de bezetting van website 1, 2 en 3*

> $x0 := \langle 1/3, 1/3, 1/3, 0, 0 \rangle$;
$state\_50 := state\_n(20, x0)$:
$plot3 := plot(state\_50, \text{alpha} = 0..1, color = [green, red, blue, purple, black],$
$linestyle = \text{"dot"})$;

$$x0 := \begin{bmatrix} \frac{1}{3} \\ \frac{1}{3} \\ \frac{1}{3} \\ 0 \\ 0 \end{bmatrix}$$



> *#Warning, die plots klopppen niet, maar moet gewoonweg gevult worden met de juiste J*

>

>

>

>