Daniel Cu Sánchez – A01703613

Which of the transition matrices in Exercises 19–22 are regular?

19. $\begin{bmatrix} 0.2 & 0.8 \\ 0.9 & 0.1 \end{bmatrix}$ **20.** $\begin{bmatrix} 1 & 0 \\ 0.6 & 0.4 \end{bmatrix}$ **21.** $\begin{bmatrix} 0 & 1 & 0 \\ 0.4 & 0.2 & 0.4 \\ 1 & 0 & 0 \end{bmatrix}$ **22.** $\begin{bmatrix} 0.3 & 0.5 & 0.2 \\ 1 & 0 & 0 \\ 0.5 & 0.1 & 0.4 \end{bmatrix}$

Una matriz es regular si en alguna potencia NO hay 0s.

19 – Es regular

$$\begin{pmatrix} 0.2 & 0.8 \\ 0.9 & 0.1 \end{pmatrix}^{30} = \begin{pmatrix} \frac{661777964317818054269463448 97}{125000000000000000000000000000} & \frac{588222035682181945730536551 03}{125000000000000000000000000000} \\ \frac{529399832113963751157482895927}{100000000000000000000000000000} & \frac{470600167886036248842517104073}{100000000000000000000000000000} \end{pmatrix}$$

20 – NO es regular

$$\begin{pmatrix} 1 & 0 \\ 0.6 & 0.4 \end{pmatrix}^{90} = \begin{pmatrix} 1 & 0 \\ \frac{807793566946316088741610050849573097947423350266259281985641401}{807793566946316088741610050849573099185363389551639556884765625} & \frac{123794003928538027489912422 4}{807793566946316088741610050849573099185363389551639556884765625} \end{pmatrix}$$

21 – Es regular

$$\begin{pmatrix} 0 & 1 & 0 \\ 0.4 & 0.2 & 0.4 \\ 1 & 0 & 0 \end{pmatrix}^{10} = \begin{pmatrix} \frac{701852}{1953125} & \frac{887531}{1953125} & \frac{363742}{1953125} \\ \frac{3593772}{9765625} & \frac{4396791}{9765625} & \frac{1775062}{9765625} \\ \frac{141132}{390625} & \frac{181871}{390625} & \frac{67622}{390625} \end{pmatrix}$$

22 – Es regular

$$\begin{pmatrix} 0.3 & 0.5 & 0.2 \\ 1 & 0 & 0 \\ 0.5 & 0.1 & 0.4 \end{pmatrix}^{11} = \begin{pmatrix} \frac{53420271567}{100000000000} & \frac{28692369359}{100000000000} & \frac{8943679537}{50000000000} \\ \frac{5382339909}{10000000000} & \frac{2836990277}{10000000000} & \frac{890334907}{5000000000} \\ \frac{10724349351}{20000000000} & \frac{28531047491}{100000000000} & \frac{8923602877}{50000000000} \end{pmatrix}$$

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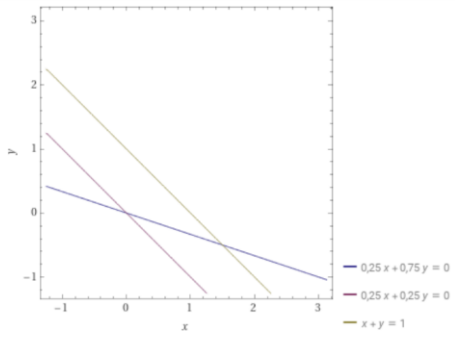
Find the equilibrium vector for each transition matrix in Exercises 23–26.

23. $\begin{bmatrix} \frac{1}{4} & \frac{3}{4} \\ \frac{1}{2} & \frac{1}{2} \end{bmatrix}$ **24.** $\begin{bmatrix} 0.3 & 0.7 \\ 0.4 & 0.6 \end{bmatrix}$ **25.** $\begin{bmatrix} 0.1 & 0.1 & 0.8 \\ 0.4 & 0.4 & 0.2 \\ 0.1 & 0.2 & 0.7 \end{bmatrix}$ **26.** $\begin{bmatrix} 0.5 & 0.2 & 0.3 \\ 0.1 & 0.4 & 0.5 \\ 0.2 & 0.2 & 0.6 \end{bmatrix}$

23 – No tiene vector de equilibrio

$\{0{,}25\,x + 0{,}75\,y = 0,\ 0{,}25\,x + 0{,}25\,y = 0,\ x + y = 1\}$

Representación del conjunto de soluciones



Forma alternativa asumiendo x e y son reales

$\{x + 3\,y = 0,\ x + y = 0,\ x + y = 1\}$

$\{0{,}25\,x + 0{,}75\,y + 0 = 0,\ 0{,}25\,x + 0{,}25\,y + 0 = 0,\ x + y = 1\}$

Formas alternativas

$\{y = -0{,}333333\,x,\ y = -x,\ y = 1 - x\}$

$\{x + 3\,y = 0,\ x + y = 0,\ x + y = 1\}$

$\{0{,}25\,(x + 3\,y) = 0,\ 0{,}25\,(x + y) = 0,\ x + y = 1\}$

Soluciones

(no existen soluciones)

24 – Vector de equilibrio

0.364 0.636

25 – Vector de equilibrio

0.1687 0.2289 0.6024

26 – Vector de equilibrio

0.2500 0.2500 0.5000

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Find all absorbing states for the transition matrices in Exercises 31–34. Which are transition matrices for absorbing Markov chains?

31. $\begin{bmatrix} 0.15 & 0.05 & 0.8 \\ 0 & 1 & 0 \\ 0.4 & 0.6 & 0 \end{bmatrix}$

32. $\begin{bmatrix} 0.4 & 0 & 0.6 \\ 0 & 1 & 0 \\ 0.9 & 0 & 0.1 \end{bmatrix}$

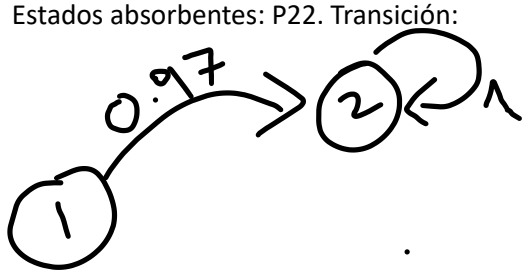
33. $\begin{bmatrix} 0.32 & 0.41 & 0.16 & 0.11 \\ 0.42 & 0.30 & 0 & 0.28 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{bmatrix}$

34. $\begin{bmatrix} 0.2 & 0.5 & 0.1 & 0.2 \\ 0 & 1 & 0 & 0 \\ 0.9 & 0.02 & 0.04 & 0.04 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

31 – Matriz NO regular

$$\begin{pmatrix} 0.15 & 0.05 & 0.8 \\ 0 & 1 & 0 \\ 0.4 & 0.6 & 0 \end{pmatrix}^{9} = \begin{pmatrix} 0.0102 & 0.9748 & 0.0149 \\ 0 & 1 & 0 \\ 0.0075 & 0.9851 & 0.0074 \end{pmatrix}$$

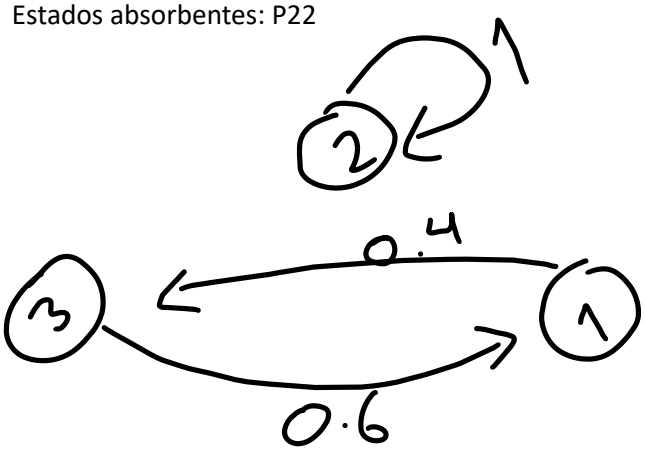
Estados absorbentes: P22. Transición:



32 – Matriz NO regular

$$\begin{pmatrix} 0.4 & 0 & 0.6 \\ 0 & 1 & 0 \\ 0.9 & 0 & 0.1 \end{pmatrix}^{11} = \begin{pmatrix} 0.5998 & 0 & 0.4002 \\ 0 & 1 & 0 \\ 0.6003 & 0 & 0.3997 \end{pmatrix}$$

Estados absorbentes: P22



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33 – Es una matriz regular

$$\begin{pmatrix} 0.32 & 0.41 & 0.16 & 0.11 \\ 0.42 & 0.30 & 0 & 0.28 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{pmatrix}^{15} = \begin{pmatrix} 0.4588 & 0.2687 & 0.0734 & 0.1991 \\ 0.4587 & 0.2687 & 0.0734 & 0.1991 \\ 0.4587 & 0.2688 & 0.0734 & 0.1991 \\ 0.4587 & 0.2687 & 0.0734 & 0.1992 \end{pmatrix}$$

No tiene estados absorbentes.

34 – Es una matriz NO regular

Display decimals, number of fraction digits: 2

$$\begin{pmatrix} 0.2 & 0.5 & 0.1 & 0.2 \\ 0 & 1 & 0 & 0 \\ 0.9 & 0.02 & 0.04 & 0.04 \\ 0 & 0 & 0 & 1 \end{pmatrix}^{17} = \begin{pmatrix} +0.00 & 0.71 & +0.00 & 0.29 \\ 0 & 1 & 0 & 0 \\ +0.00 & 0.69 & +0.00 & 0.31 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

Estados absorbentes: P22, P44