

## Chapter 9 / Example 10

# Transition matrices

Dockless bicycle company Mathbike hires bicycles in a city through a mobile phone app. Users can unlock a bicycle with their smartphone, ride it to their destination then lock the bicycle. Mathbike divides the city into three zones: Inner (I), Outer (O), and Central business district (C). By tracking their bicycles with GPS over several weeks, the company finds that at the end of each day:

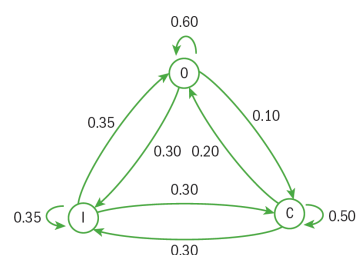
- 50% of the bicycles rented in zone C remained in zone C, 30% were left in Zone I, and 20% were left in Zone O
- 60% of the bicycles rented in zone O remained in zone O, 30% were left in zone I, and 10% were left in zone C.
- 35% of bicycles rented in zone I remained in zone I, 35% were left in zone O, and 30% were left in zone C.

**a** Show this information in a transition state diagram.

**b** Show this information in a transition matrix.

**c** Determine the probability that after three days, a bicycle that started in C is now in O.

The transition state diagram is as shown.



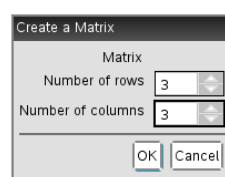
Enter the transition matrix  $T = \begin{bmatrix} 0.50 & 0.30 & 0.10 \\ 0.30 & 0.35 & 0.30 \\ 0.20 & 0.35 & 0.60 \end{bmatrix}$ .

Open a new document and add a Calculator page.

Press **menu** 7:Matrix & Vector | 1:Create | 1:Matrix.

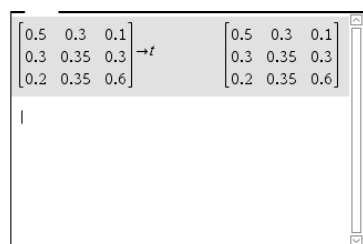
Change the number of rows and columns to 3.

Press **enter**.



Enter the values of the elements of the matrix  $T$ , using **tab** to move through the matrix.

Press **ctrl** **var** **sto→** T and press **enter**.



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Type  $T^3$  and press **enter**.

The probability that a bicycle starting in the central business district at the end of three days is in the outer zone is 0.441.

$\begin{bmatrix} 0.5 & 0.3 & 0.1 \\ 0.3 & 0.35 & 0.3 \\ 0.2 & 0.35 & 0.6 \end{bmatrix} \rightarrow T$	$\begin{bmatrix} 0.5 & 0.3 & 0.1 \\ 0.3 & 0.35 & 0.3 \\ 0.2 & 0.35 & 0.6 \end{bmatrix}$
$T^3$	$\begin{bmatrix} 0.307 & 0.2795 & 0.243 \\ 0.31575 & 0.315875 & 0.31575 \\ 0.37725 & 0.404625 & 0.44125 \end{bmatrix}$