

## 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:

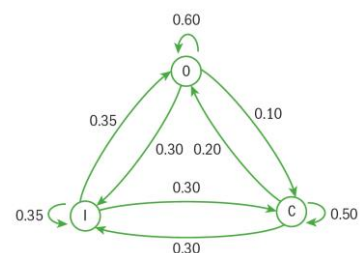
- 50% of the bicycles rented in zone C remained in zone C, 30% were left in Zone I, and 20% were left in Zone O
- 60% of the bicycles rented in zone O remained in zone O, 30% were left in zone I, and 10% were left in zone C.
- 35% of bicycles rented in zone I remained in zone I, 35% were left in zone 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  $T = \begin{pmatrix} 0.50 & 0.30 & 0.10 \\ 0.30 & 0.35 & 0.30 \\ 0.20 & 0.35 & 0.60 \end{pmatrix}$

Press **2nd** **x<sup>-1</sup>** **[MATRX]** ►► EDIT 1:[A] and press **ENTER**.

NAMES MATH EDIT  
 1:[A]  
 2:[B]  
 3:[C]  
 4:[D]  
 5:[E]  
 6:[F]  
 7:[G]  
 8:[H]  
 9↓[I]

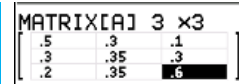
Change the dimensions of the matrix to  $3 \times 3$  and press **ENTER**.

MATRIX[A] 3 × 3  
 $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$   
 [A](1,1)= 0

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Enter the values of the elements of the  $3 \times 3$  matrix, using **ENTER** to move through the matrix.



**[A](3,3) = .6**

Press **2nd** **MODE** **QUIT**.

Press **2nd**  **$x^{-1}$**  **MATRX** 1:[A] and press **ENTER**.

Press  **$\wedge$**  **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.

