

STAT2005 Programming Languages for Statistics
Exercise for Chapter 6

1. In Country A, each person could take three possible statuses, namely (i) Occupied (state 1), (ii) Available (state 2), and (iii) Complicated (state 3). Every time, each person remains in the same status or switches to a different status according to the transition probability matrix

$$T = \begin{bmatrix} 0.7 & 0.2 & 0.1 \\ 0.3 & 0.6 & 0.1 \\ 0.2 & 0.4 & 0.4 \end{bmatrix}$$

- (a) Compute the 2-step transition probability matrix.
- (b) If a person in Country A is available at time 0, what is the probability that he will be occupied at time 8?
- (c) Risky is a citizen in Country A and he is available at time 0. He claims that there exists a positive integer n such that there has a probability higher than 50% that he will become occupied at time $n + 1$ if he is still available until time n . Justify his claim.

2. (a) Given that

$$f(x) = x|x + 2| + |x - 1|, \text{ for } -2 \leq x \leq 2.$$

Write R codes to find the minimum of $f(x)$.

(b) Given that

$$g(x_1, x_2) = \sqrt{|\sin(x_1) + \cos(x_2)|}.$$

- (i) Write R codes to find the minimum of $g(x_1, x_2)$ with initial values $(x_1, x_2) = (3, 3)$.
- (ii) Produce a 3-dimensional plot of $g(x_1, x_2)$ for $x = -5$ to $x = 5$.

3. $f(x) = 2x - x \cos x$

- (a) Write R codes to find $f^{(10)}(x)$, the 10-th derivative of $f(x)$.
- (b) Integrate $f(x)$ from $x = 0$ to $x = 1$.