Applied Discrete Modelling

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Assignment- 1

**System Specification:**

A quality tester is fed by material flows from two different sources. Only one of the two sources can be active, either *source 0* or *source 1*. The probability to switch from source 0 to source1 in one step is 0.4. The one step transition probability from source 1 to source 0 is 0.3. At the beginning of the simulation source 0 is active.

Assuming, that in each time step, one item is produced, the probability for the item to test OK is 0.9 for source 0 and 0.95 for source 1.

**Implementation:**

Construct a general DTMC solution program in a programming language of your choice. The program should compute steady state and transient solutions and import DTMC specifications in the format given in the exercise.

**Tasks and Questions:**

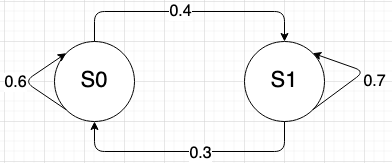
Specify and draw the DTMC representing the system.

Use your program to answer the following questions:

* What is the probability that source 0 is active after 8 minutes if one time step represents one minute?
* What is the probability of producing an OK item in the next minute?
* Does this model have limiting or stationary solutions? Why?
* How long does the system need to reach a stationary solution?
* What is the probability for source 0 to be active in steady state?
* What is the average probability of producing an OK item in steady state?

**Task 01:** Specify and Draw the DTMC for the system

Sol: State transition diagram for the given system. Here “S0” is the state 0 and “S1” is the sate 1.



**Task 02:** Programming questions

**2.1** What is the probability that source 0 is active after 8 minutes if one time step represents one minute?

Sol: To calculate the probability of source 0 being active after 8 minutes, we need to calculate the probability transition matrix after 8 time steps (8 minutes). We can calculate this by calculating the “**n-step transition probability**”.

Original state transition matrix: **P** = =

To calculate the transition matrix after 8 time steps we need to calculate P8.

So after 8 times steps the probability of source 0 being active will be: 0.428608919

**2.2** What is the probability of producing an OK item in the next minute?

Sol: To calculate the probability of an item being “OK” we have to calculate the probability of “OK” items from both 0 and 1 sources.

Probability that the OK item was produced by source 0: P(OK| Source 0) \* P(Source 0)

Probability that the OK item was produced by source 1: P(OK| Source 1) \* P(Source 1)

So, P(OK) = P(OK| Source 0) \* P(Source 0) + P(OK| Source 1) \* P(Source 1) = 0.79285925

**2.3** Does this model have limiting or stationary solutions? Why?

Sol: Yes, the model reaches a limiting or stationary solution because we do not see any further significant updates in the transition probabilities of the states.

**2.4** How long does the system need to reach a stationary solution?

Sol: The system takes 32 steps to reach a stationary solution.

**2.5** What is the probability for source 0 to be active in steady state?

Sol: The probability for source 0 to be active in steady state is 0.42857142.

**2.6** What is the average probability of producing an OK item in steady state?

Sol: The average probability of producing an OK item in steady state is 0.792857.