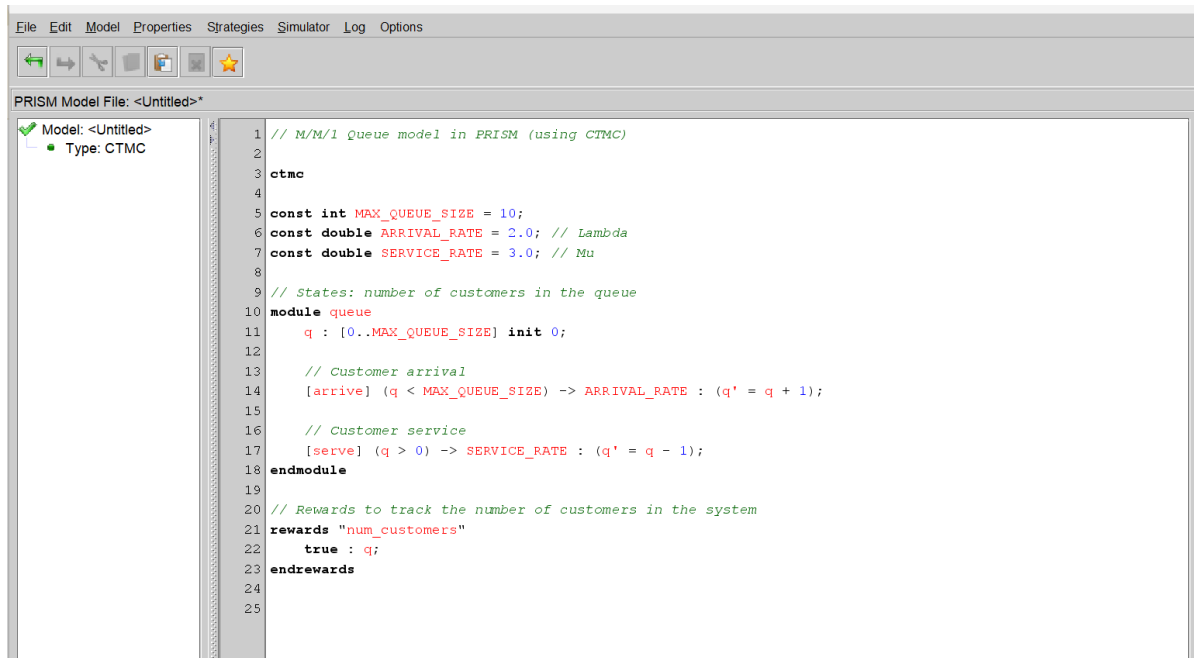


Verifying a Queueing Model with PRISM Model Checker

1. Modeling the Queueing System

PRISM model for an M/M/1 queue



The screenshot shows the PRISM Model Checker interface. The top menu bar includes File, Edit, Model, Properties, Strategies, Simulator, Log, and Options. Below the menu is a toolbar with icons for navigation and execution. The main window displays the PRISM model file, which is an M/M/1 queue model using CTMC (Continuous Time Markov Chain).

```
1 // M/M/1 Queue model in PRISM (using CTMC)
2
3 ctmc
4
5 const int MAX_QUEUE_SIZE = 10;
6 const double ARRIVAL_RATE = 2.0; // Lambda
7 const double SERVICE_RATE = 3.0; // Mu
8
9 // States: number of customers in the queue
10 module queue
11     q : [0..MAX_QUEUE_SIZE] init 0;
12
13     // Customer arrival
14     [arrive] (q < MAX_QUEUE_SIZE) -> ARRIVAL_RATE : (q' = q + 1);
15
16     // Customer service
17     [serve] (q > 0) -> SERVICE_RATE : (q' = q - 1);
18 endmodule
19
20 // Rewards to track the number of customers in the system
21 rewards "num_customers"
22     true : q;
23 endrewards
24
25
```

2. Defining Properties

- Steady-state probability that the system is empty

$$S = ? [q=0]$$

property calculates the steady-state probability that the number of customers in the queue is zero.

- Expected number of customers in the queue

$$R\{\text{"num_customers"}\} = ? [S]$$

property calculates the expected number of customers in the queue by using the reward structure defined in the model

