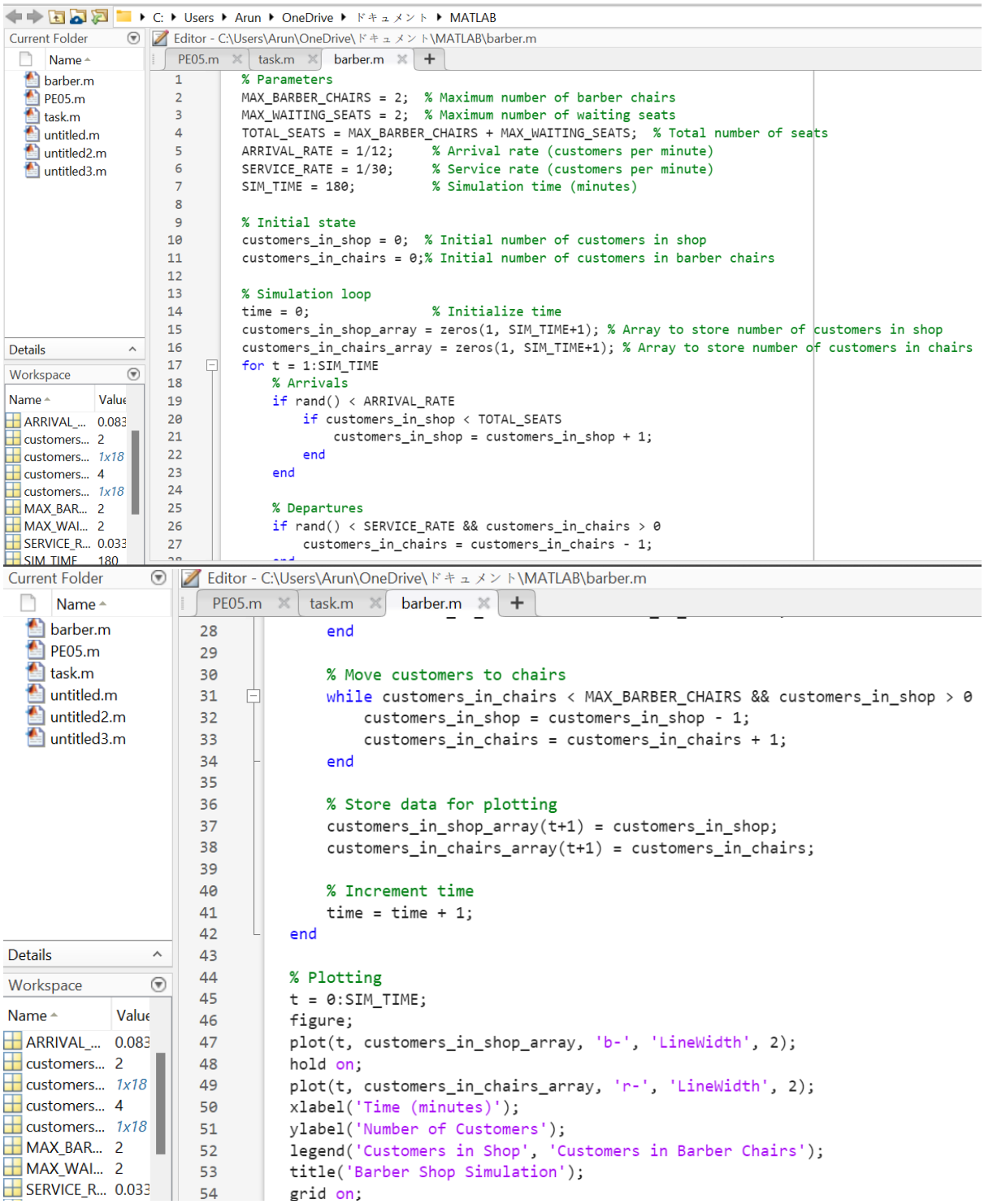
Barber shop model using Matlab

MATLAB code



```
% Parameters
MAX_BARBER_CHAIRS = 2;  % Maximum number of barber chairs
MAX_WAITING_SEATS = 2;  % Maximum number of waiting seats
TOTAL_SEATS = MAX_BARBER_CHAIRS + MAX_WAITING_SEATS;  % Total number of seats
ARRIVAL_RATE = 1/12;     % Arrival rate (customers per minute)
SERVICE_RATE = 1/30;     % Service rate (customers per minute)
SIM_TIME = 180;          % Simulation time (minutes)

% Initial state
customers_in_shop = 0;  % Initial number of customers in shop
customers_in_chairs = 0;% Initial number of customers in barber chairs

% Simulation loop
time = 0;                % Initialize time
customers_in_shop_array = zeros(1, SIM_TIME+1); % Array to store number of customers in shop
customers_in_chairs_array = zeros(1, SIM_TIME+1); % Array to store number of customers in chairs
for t = 1:SIM_TIME
    % Arrivals
    if rand() < ARRIVAL_RATE
        if customers_in_shop < TOTAL_SEATS
            customers_in_shop = customers_in_shop + 1;
        end
    end

    % Departures
    if rand() < SERVICE_RATE && customers_in_chairs > 0
        customers_in_chairs = customers_in_chairs - 1;
    end

    % Move customers to chairs
    while customers_in_chairs < MAX_BARBER_CHAIRS && customers_in_shop > 0
        customers_in_shop = customers_in_shop - 1;
        customers_in_chairs = customers_in_chairs + 1;
    end

    % Store data for plotting
    customers_in_shop_array(t+1) = customers_in_shop;
    customers_in_chairs_array(t+1) = customers_in_chairs;

    % Increment time
    time = time + 1;
end

% Plotting
t = 0:SIM_TIME;
figure;
plot(t, customers_in_shop_array, 'b-', 'LineWidth', 2);
hold on;
plot(t, customers_in_chairs_array, 'r-', 'LineWidth', 2);
xlabel('Time (minutes)');
ylabel('Number of Customers');
legend('Customers in Shop', 'Customers in Barber Chairs');
title('Barber Shop Simulation');
grid on;
```

Output

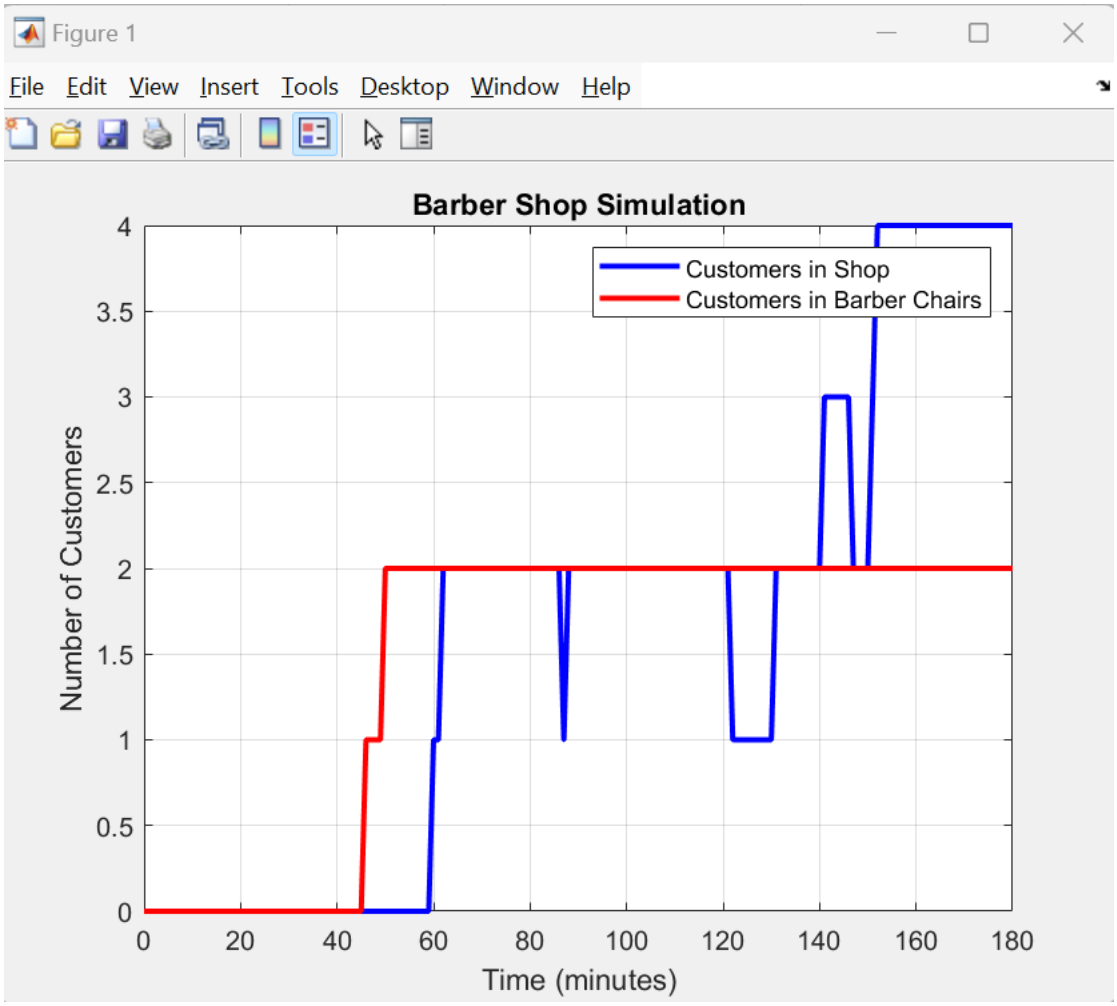


Figure 1
File Edit View Insert Tools Desktop Window Help
Barber Shop Simulation
Customers in Shop
Customers in Barber Chairs
Number of Customers
Time (minutes)
0
0.5
1
1.5
2
2.5
3
3.5
4
0
20
40
60
80
100
120
140
160
180

Barber shop model using PRISM

1.Modeling the Queueing System

Arrival Rate: Customers arrive at a rate λ per hour.

Service Rate: Each barber services customers at a rate μ per hour.

Total Seats: 2 barber chairs + 2 waiting seats.

Model: barber.pm
Type: CTMC

```
ctmc
const int N = 4; // Maximum number of customers
const int M = 2; // Number of servers
const double lambda = 1.0 / 12.0; // Arrival rate (customers/hour)
const double mu = 1.0 / 30.0; // Departure rate (customers/hour)
const double sim_time = 3.0 * 60.0; // Work time (3 hours)
// States
module queueing_system
queue_length : [0..N]; // Queue length can range from 0 to N
server_status : [0..M]; // Number of servers in use can range from 0 to M
// Arrivals (Customers arrive when the queue length is less than N)
[] queue_length < N -> lambda : (queue_length' = queue_length + 1);
// Departures (Customers depart when the queue length is greater than 0 and there are servers available)
[] queue_length > 0 & server_status > 0 -> mu : (queue_length' = queue_length - 1);
// Server allocation (Servers are allocated when there are available servers and customers in the queue)
[] server_status < M & queue_length > 0 -> (server_status' = server_status + 1);
// Server deallocation (Servers are deallocated when there are customers being served)
[] server_status > 0 -> (server_status' = server_status - 1);
endmodule
// Properties
const double end_time = sim_time;
rewards "time"
true : end_time;
endrewards
```

Built Model
States: ?
Initial states: ?
Transitions: ?