ISLAMIC UNIVERSITY OF TECHNOLOGY

Organization of Islamic Cooperation

Board Bazar, Gazipur

Assignment 01

CSE 4549

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# Task 1

We know the arrival rate to be and the departure rate to be . For each state, other than state , this means that the rate at which the system enters the state is and the rate at which the system leaves the state is . For state , the rates are and respectively.

We also know that the system must be a stable system. This means,

This is true everywhere except in state , where the equation is simple .

The probability of the system being in the th state is . Thus,

State

State ,

Solving each of the equations above simultaneously gives us

We know that the sum of the probabilities for all state must be . Thus,

From here, we can find .

From here, we can find , .

Assuming all values of are equal and all values of are equal,

Here, can be denoted as , the traffic intensity.

is a geometric series. Thus,

Using this equation, we can find the job-average number of customers in the system, .

Thus, the average number of customers in the queue, , is given by

Using Little’s Law, we can prove that the average waiting time in the queue is

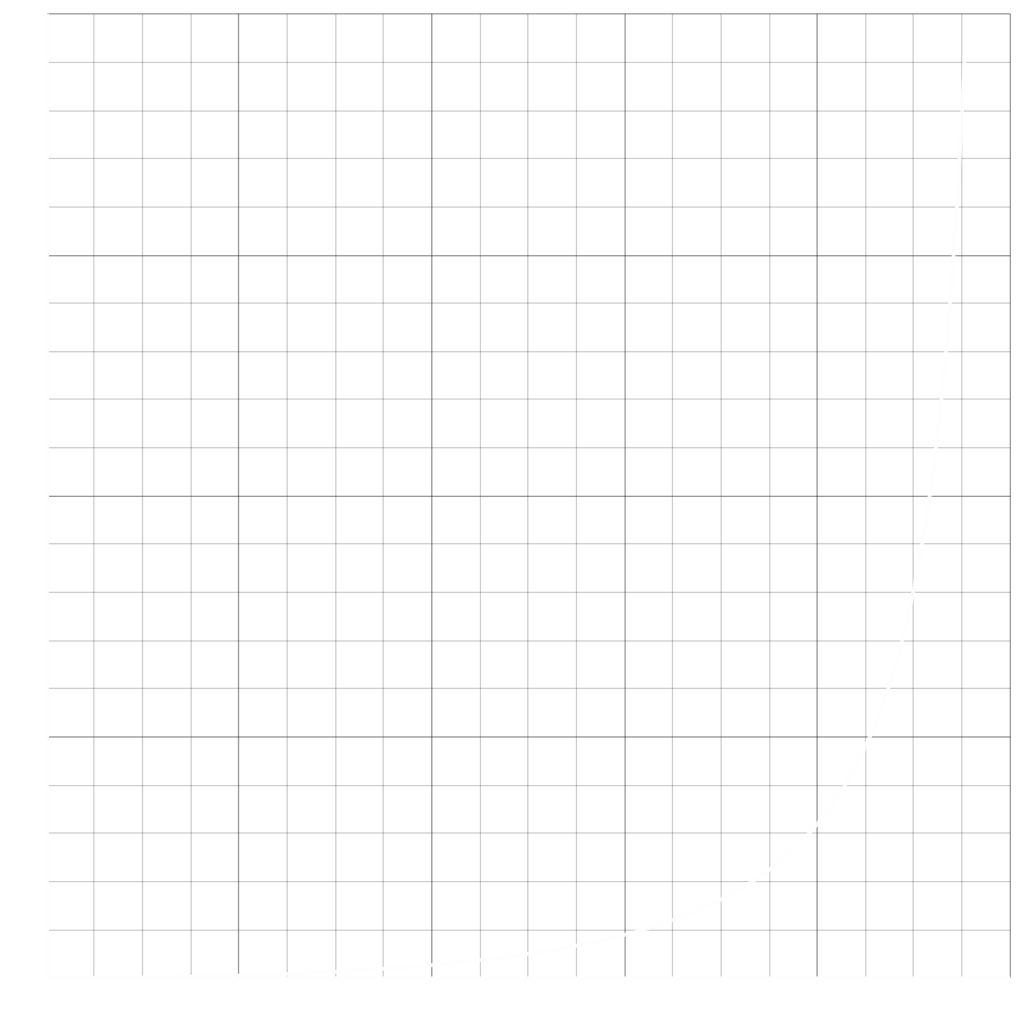
# Task 2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Mean inter-arrival time** | **Mean service time** | **Traffic Intensity** | **Average delay in queue** | **Average number in queue** | **Server utilization** |
| 1 | 0.05 | 0.05 | 0.004 | 0.004 | 0.048 |
| 1 | 0.1 | 0.1 | 0.014 | 0.014 | 0.095 |
| 1 | 0.15 | 0.15 | 0.031 | 0.031 | 0.143 |
| 1 | 0.2 | 0.2 | 0.061 | 0.060 | 0.192 |
| 1 | 0.25 | 0.25 | 0.088 | 0.087 | 0.237 |
| 1 | 0.3 | 0.3 | 0.137 | 0.136 | 0.289 |
| 1 | 0.35 | 0.35 | 0.193 | 0.192 | 0.339 |
| 1 | 0.4 | 0.4 | 0.236 | 0.235 | 0.378 |
| 1 | 0.45 | 0.45 | 0.356 | 0.361 | 0.429 |
| 1 | 0.5 | 0.5 | 0.430 | 0.418 | 0.46 |
| 1 | 0.55 | 0.55 | 0.628 | 0.620 | 0.522 |
| 1 | 0.6 | 0.6 | 0.711 | 0.688 | 0.545 |
| 1 | 0.65 | 0.65 | 0.988 | 0.989 | 0.614 |
| 1 | 0.7 | 0.7 | 1.602 | 1.593 | 0.674 |
| 1 | 0.75 | 0.75 | 1.446 | 1.373 | 0.655 |
| 1 | 0.8 | 0.8 | 2.646 | 2.551 | 0.722 |
| 1 | 0.85 | 0.85 | 3.668 | 3.660 | 0.824 |
| 1 | 0.9 | 0.9 | 12.076 | 12.340 | 0.915 |
| 1 | 0.95 | 0.95 | 16.538 | 16.662 | 0.939 |
| 1 | 1 | 1 | 12.823 | 12.673 | 0.956 |

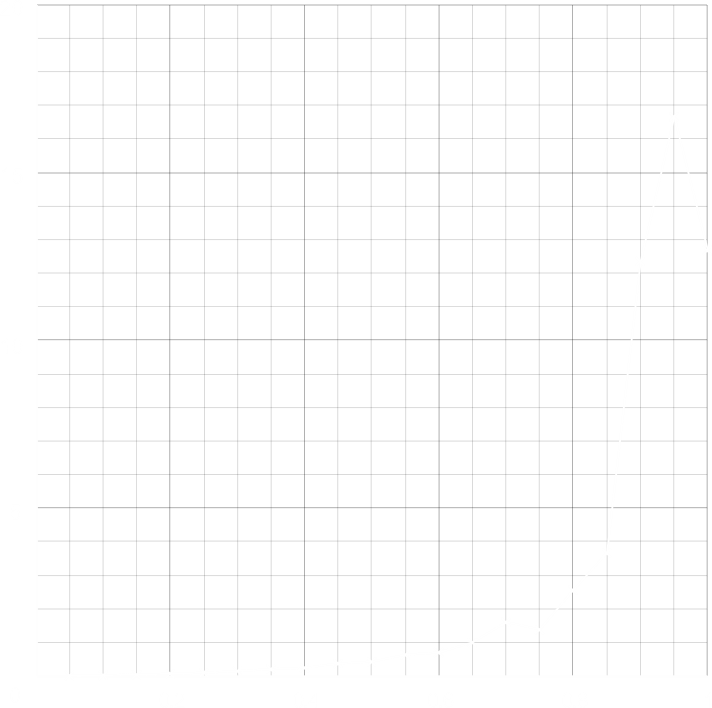
# Task 3

## Average number of customers in the queue against traffic intensity

Based on Analytical Results:

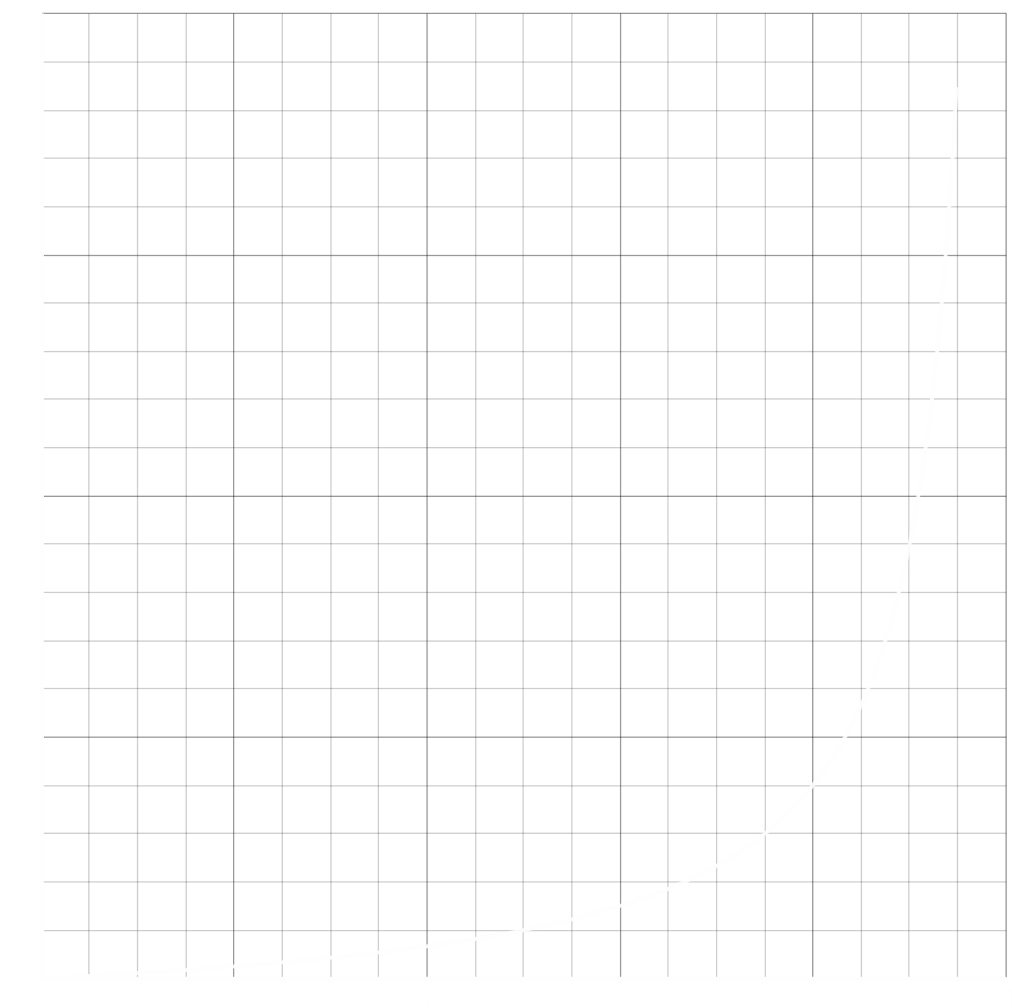


Based on Simulation Results:



## Average waiting time in queue

Based on Analytical Results:



Based on Simulation Results:

