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| ECE 358 S20 |
| M/M/1 and M/M/1/K Queue Simulation |
| Lab 1 |

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# Question 1

Our code generated the following experimental results for the mean and variance of 1000 exponential random variables

|  |  |
| --- | --- |
| Mean | Variance |
| 0.0137490037457974 | 0.000184033045328294 |

For an exponential random variable, the mean is . For , this is .

The percentage error between this and the experimental value is

For an exponential random variable, the variance is . For , this is .

The percentage error between this and the experimental value is

The percent errors for these two values is small enough that our exponential random variable generator code won’t negatively impact the remainder of the experiment.

# Question 2

## Packet Generation

### expn\_random function



Figure 1 Helper function that generates an exponential random number

### gen\_ functions



Figure 2 Helper function to generate arrival events based on rate of arrival and simulation time. Stores events as list of dictionaries



Figure 3 Helper function to generate observer events based on rate of arrival and simulation time. Stores events as list of dictionaries



Figure 4 Function to generate departure events based on arrival events. Works in similar fashion to gen\_arrival and gen\_observer

* Question1 function

## M/M/1

* Simulatemm1 function
* Question3 and question4 functions

## M/M/1/K

* Simulatemm1k function
* Question 6 function

# Question 3

Figure Graph showing the trend of average number of packets in queue (E[N]) with variation in traffic intensity/queue utilization. Shows results from simulation time T = 1000 (blue) and T = 2000 (red)

Figure Graph showing the trend of probability of an idle server with variation in traffic intensity/queue utilization. Shows results from simulation time T = 1000 (blue) and T = 2000 (red)

# Question 6

Figure 7 Graph showing the trend of average number of packets in queue (E[N]) with variation in traffic intensity/queue utilization. Shows results with buffer size K=10, 25, 50.

Figure 8 Graph showing the trend of probability of packet loss with variation in traffic intensity/queue utilization. Shows results with buffer size K=10, 25, 50.