Exercise 5:

We consider a traffic source that generates traffic according to the following process:

- We have Poisson arrivals with mean rate λ.
- Each arrival triggers the generation of packets of a message. A message has a length in packets according to an exponential distribution with mean value L. The packets of a message are not instantaneously produced, but they are generated at a constant rate of *r* packets per second.

We are required to determine the distribution of the number of packets simultaneously generated by the source at a generic instant.

Solution:

The source can be generalized as a M/M/∞ queuing process with infinite capacity. This is due to the fact that the arrival of messages is Poisson, moreover the "service" for each message is instantaneous with duration corresponding to the time taken to generate all the packets for a message. The state of the queue is the number of messages simultaneously active, i.e. the number of messages simultaneously present in the source. The mean service time of a message is equal to L/r. The traffic intensity offered to the queue is $\rho = \lambda * L/r$ Erlangs. There are no stability problems, as the number of servers in infinite. As per the M/M/∞ model, the state probability is

$$P_i = (\rho^i/i!) * P_0,$$

where the following holds:

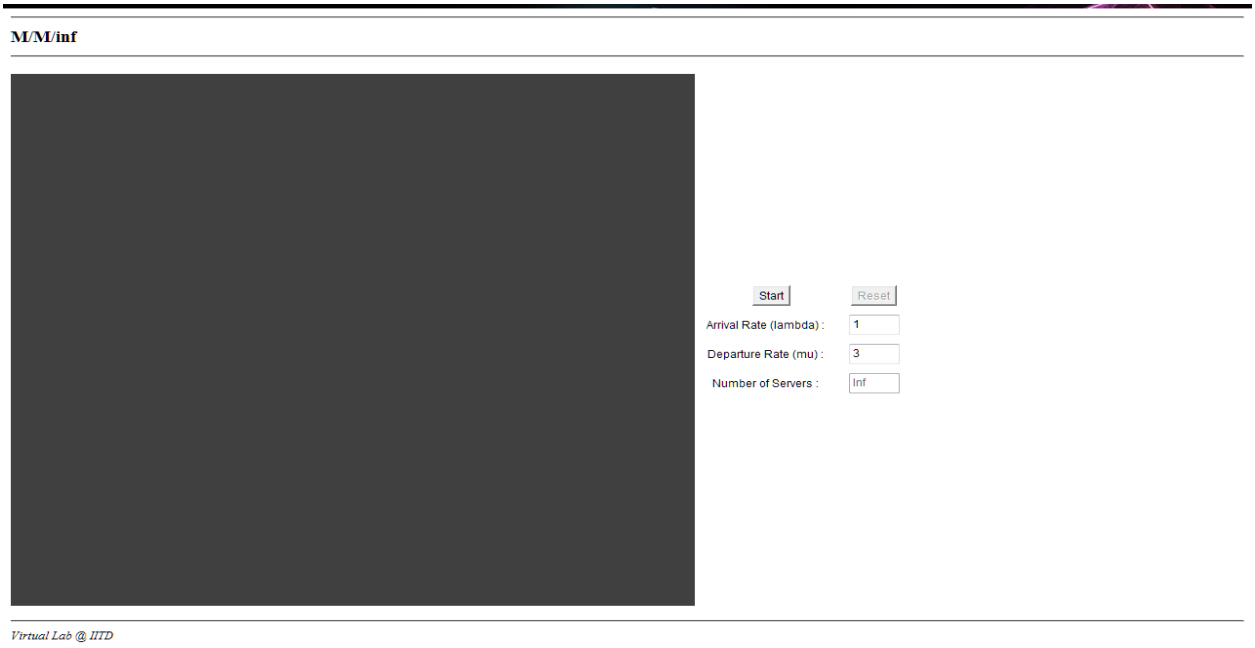
$$P_0 = \frac{1}{\sum \frac{\rho^i}{i!}} = e^{-\rho}$$

However, this is also the probability that the traffic generator has simultaneously produced *i* packers (each message corresponds to one packet, and no packet comes from two messages)

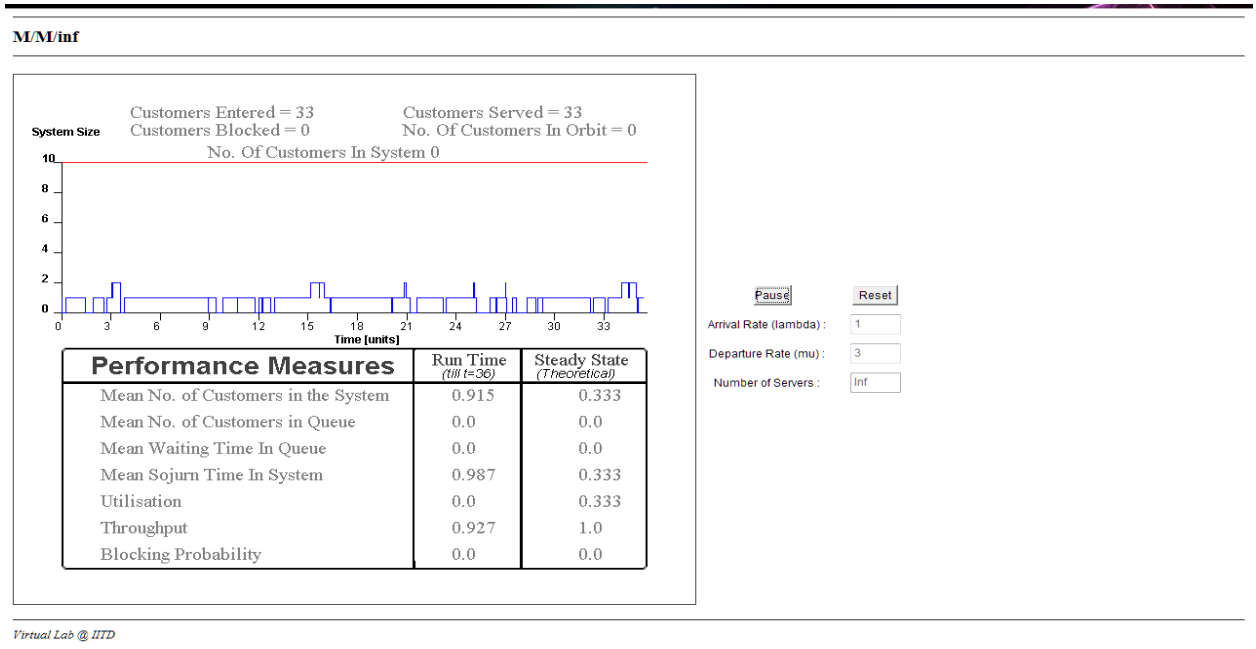
Simulation:

For simulation of the traffic generator, perform the following steps:

→ Open the page where the simulation is to be performed.
→ Next feed the data as shown. Put lambda (λ) = 1 and mu (μ) = 3 (L/r = 3, in this case)



→ Click Start. The applet will now generate a sample path for the queue.



Performance Measures	Run Time (till t=36)	Steady State (Theoretical)
Mean No. of Customers in the System	0.915	0.333
Mean No. of Customers in Queue	0.0	0.0
Mean Waiting Time In Queue	0.0	0.0
Mean Sojurn Time In System	0.987	0.333
Utilisation	0.0	0.333
Throughput	0.927	1.0
Blocking Probability	0.0	0.0

→ We see that the steady state data obtained from the applet matches beautifully with the theoretically calculated data.