Exercise 3:

A Drive-It-Through-Yourself Car Wash decides to change its operating procedure. It will install new machinery which will permit the washing of two cars at once (one if there are now other waiting cars) and will move to a new location which will effectively have no waiting capacity limitation. The company expects arrivals to be Poisson with mean 20 per hour, and its service times to be exponential with mean of 5 min. What average line length should it anticipate?

Solution:

The model for this bulk-service problem is of the type $M/M^{[K]}/1$. The parameters are λ = 20/hr, μ = 1/(5 min) = 12/hour, and K = 2. The operator equation for the operation of the carwash is therefore:

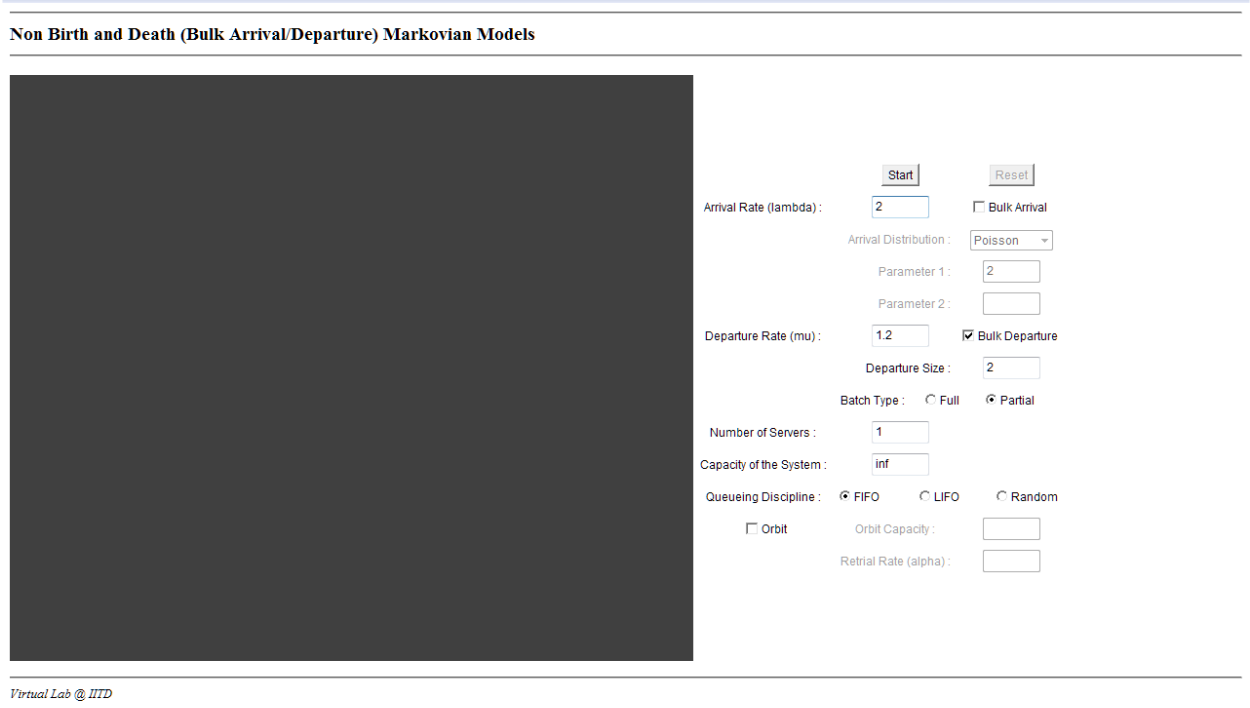
$$12r^3 - 32r + 20 = 0$$

The roots are 1, $(-3 + (69^{1/2}))/6$ and $(-3 - (69^{1/2}))/6$.
We select the positive root with absolute value less than 1, i.e. the second one. Thus, r = 0.884. Therefore,

L = 0.884/(1-0.884) = 7.6 cars and L_q = 7.6 – (20/12) = 5.9 cars.

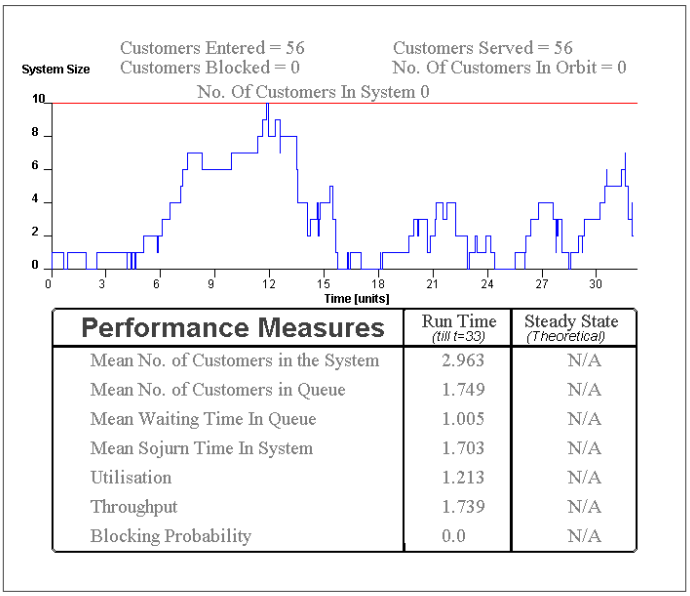
For a simulation of the car wash, perform the following steps:

→ Open the page where the simulation is to be performed.
→ Next feed the data as shown.



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

Non Birth and Death (Bulk Arrival/Departure) Markovian Models



Performance Measures	Run Time (till t=33)	Steady State (Theoretical)
Mean No. of Customers in the System	2.963	N/A
Mean No. of Customers in Queue	1.749	N/A
Mean Waiting Time In Queue	1.005	N/A
Mean Sojurn Time In System	1.703	N/A
Utilisation	1.213	N/A
Throughput	1.739	N/A
Blocking Probability	0.0	N/A