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:

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The model for this bulk-service problem is of the type $M/M^{[K]}/1$. The parameters are $\lambda = 20/hr$, $\mu = 1/(5 min) = 12/hour$, 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.

Arrival Rate (lambda):

Arrival Cate (lambda):

Parameter 1:

Parameter 2:

Parameter 2:

Departure Rate (mu):

12

Parameter 2:

Departure Size:

Departure Size:

Capacity of the System:

Queueing Discipline:

Outel Capacity:

Retrial Rate (alpha):

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

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

System Size		Customers Serv	ved = 56 ers In Orbit = 0
-	No. Of Customers In Syst		cis iii Oibit 0
10	110. Of Customers in System	ciii v	
8 _			
6 _			ı
4 _	선 낚시	пп	/
2 _		"пј"Ц.,	
	╼╥┙╹	ᆜᆝᆝᆝ	
0 3	6 9 12 15 18	21 24	27 30
	Time [units]	Run Time	Steady State
P	erformance Measures	(till t=33)	(Theoretical)
N.	Iean No. of Customers in the System	2.963	N/A
N	Iean No. of Customers in Queue	1.749	N/A
N	lean Waiting Time In Queue	1.005	N/A
N.	Iean Sojurn Time In System	1.703	N/A
U	tilisation	1.213	N/A
T	hroughput	1.739	N/A
	locking Probability	0.0	N/A

		Pause	Reset
	Arrival Rate (lambda) :	2	☐ Bulk Arrival
		Arrival Distribution :	Poisson 🔻
		Parameter 1 :	2
		Parameter 2 :	
	Departure Rate (mu):	1.2	Bulk Departure
		Departure Size :	2
		Batch Type : C Full	 Partial
	Number of Servers :	1	
	Capacity of the System :	inf	
	Queueing Discipline :	€ FIFO C LIFO	C Random
	☐ Orbit	Orbit Capacity:	
		Retrial Rate (alpha):	
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