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CEE 598 Topic: Traffic Simulation Modelling and Applications

Homework No.3

Exercise 2-1:

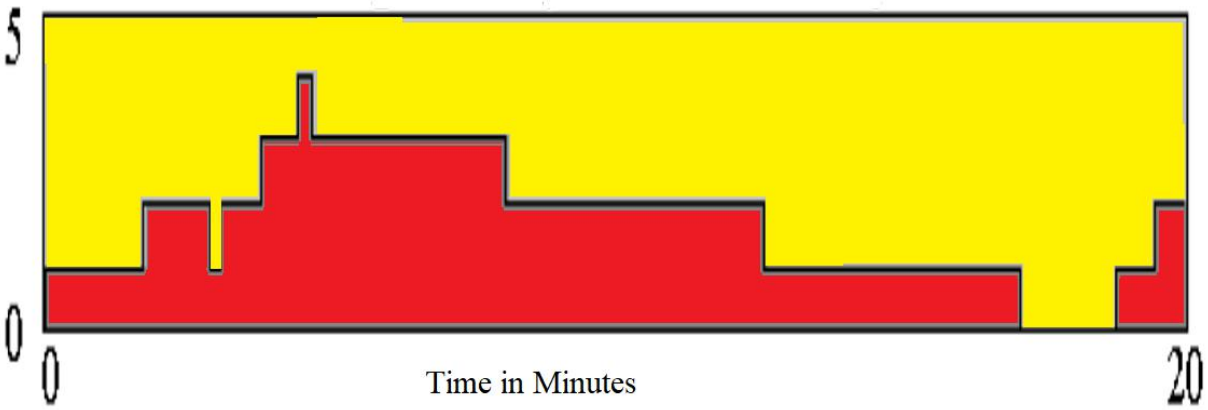
$S(t)$ = the total number of parts in the system (in queue plus in service) at time t.

□S denote the area under $S(t)$ up to the event time at a row in the table.

S^* be the maximum value of $S(t)$ observed up to the event time in the row.

Entity No.	Time (t)	S(t)	□S	S*
-	0	0	0	0
1	0	1	0	1
2	1.73	2	1.73	2
1	2.9	1	4.07	2
3	3.08	2	4.25	2
4	3.79	3	5.67	3
5	4.41	4	7.53	4
2	4.66	3	8.53	4
3	8.05	2	18.79	4
4	12.57	1	27.74	4
5	17.03	0	32.2	4
6	18.69	1	32.2	4
7	19.39	2	32.9	4
-	20	2	**34.12**	4

The figure below shows the drilling center queue, Number in the system



The time-average number in system = 34.12/20 = 1.706

the maximum number in system = 4.

Exercise 2-2:

Yes, in the previous exerxise, we created some varibels in columns such as:

$S(t)$ = the total number of parts in the system (in queue plus in service) at time t.

S denote the area under $S(t)$ up to the event time at a row in the table.

S^* be the maximum value of $S(t)$ observed up to the event time in the row.

Regarding the maximum number in the system, this number can be observed up to the event time in the row.

Exercise 2-3:

Using the same table in 2-1. The parts that in service and in queue can be represented vertically with the first entry's being the arrival time (top). the second entry is being the service requirement (bottom). The queue ranked be in the decreasing order for the service requirement. The resulting highlighted in the table shows entries that are different from table 2-2 which were caused by moving from FIFO to SPT queue discipline.

Just-Finished Event			Variables		Attributes		Statistical Accumulators								Event Calendar
Entity No.	Time t	Event Type	Q(t)	B(t)	Arrival Times: (In Queue)	In Service	P	N		WQ	WQ*	TS	TS*		[Entity No., Time, Type]
5	4.41	Arr	3	1	(3.79, 4.41, 3.08) (4.52, 4.46, 3.39)	1.73 1.76	1	2	1.17	1.17	2.90	2.90	3.12	3 4.41	[2, 4.66, Dep] [6, 18.69, Arr] [–, 20.00, End]
2	4.66	Dep	2	1	(3.79, 4.41 [4.52, 4.46)	3.08 3.39	2	3	2.75	1.58	5.83	2.93	3.87	3 4.66	[3, 8.05, Dep] [6, 18.69, Arr] [–, 20.00, End]
3	8.05	Dep	1	1	(3.79 (4.52)	4.41 4.46	3	4	6.39	3.64	10.80	4.97	10.65	3 8.05	[5, 12.51 , Dep] , [6, 18.69Arr] , end] [–, 20.00
5	12.51	Dep	0	1	())	3.79 4.52	4	5	15.11	8.72	18.90	8.10	15.11	312.5 1	[4, 17.03, Dep] [6, 18.69, Arr] [–, 20.00, End]
4	17.03	Dep	0	0	() ()	– –	5	5	15.11	8.72	32.14	13.24	15.11	3 17.0 3	[6, 18.69, Arr] [–, 20.00, End]
6	18.69	Arr	0	1	() ()	18.69 4.36	5	6	15.11	8.72	32.14	13.24	15.11	3 17.0 3	[7, 19.39, Arr] [–, 20.00, End] [6, 23.05, Dep]
7	19.39	Arr	1	1	(19.39) (2.07)	18.69 4.36	5	6	15.11	8.72	32.14	13.24	15.11	3 17.7 3	[–, 20.00, End] [6, 23.05, Dep] [8, 34.91, Arr]
-	20.00	End	1	1	(19.39) (2.07)	18.69 4.36	5	6	15.11	8.72	32.14	13.24	15.72	3 18.3 4	[6, 23.05, Dep] [8, 34.91, Arr]

This rule has an influence after the arrival of entity 5 at time = 4.41, which the service tine (4.46) is less than the service rime of entity 4 (4.52) and this already in queue, and the entity 5 be ahead of entity 4 in this case. The final performance listed in the following table:

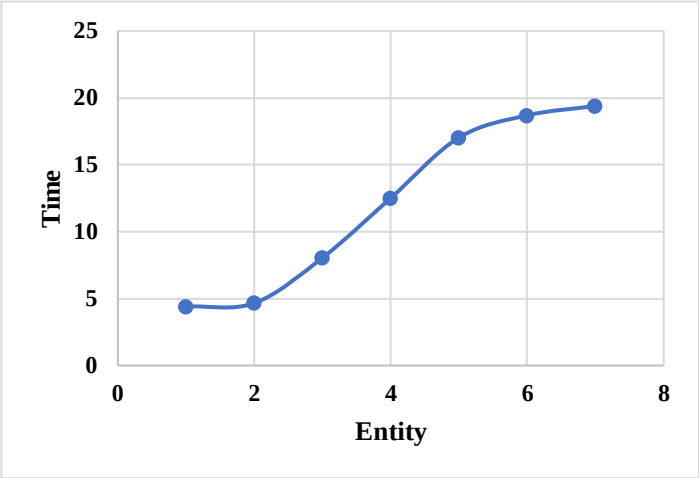
Performance Measure	Value	Result from Table 2-3	Change
Total production	5 parts	5 parts	No change
Average waiting time in queue	2.52 minutes per part (6 p arts)	2.53 minutes per part (6 parts)	Decreased
Maximum waiting time in queue	8.72 minutes	8.16 minutes	Increased
Average total time in system	6.43 minutes per part (5 rts)	6.44 minutes per part (5 parts)	Decreased
Maximum total time in system	13.24 minutes	12.62 minutes	Increased
Time-average number of parts in queue	0.79 part	0.79 part	No change
Maximum number of parts in queue	3 parts	3 parts	No change
Drill-press utilization	0.92 (dimensionless proportion)	0.92 (dimensionless proportion)	No change

The effect of SPT is different than FIFO in terms of the average total time and the average waiting time which gets better, the maximum of those measures got worse. the measure depends mainly on the resulting performance.

It is possible to put the entities into the queue and then see the service requirement attribute to decide which entity to remove. Inserting the entity in the right place requires searching less than the whole queue, while picking the minimum requirement out of unordered queue need searching the entire queue to make sure getting the minimum.

Exercise 2-4:

The table and figure below show the entities and the corresponding time



Entity No.	Time
1	4.41
2	4.66
3	8.05
4	12.51
5	17.03
6	18.69
7	19.39

Performance Measure	Value	Result from Table 2-3	Change
Total production	5 parts	5 parts	No change
Average waiting time in queue	2.52 minutes per part (6 p arts)	2.53 minutes per part (6 parts)	Decreased
Maximum waiting time in queue	8.72 minutes	8.16 minutes	Increased
Average total time in system	6.43 minutes per part (5 rts)	6.44 minutes per part (5 parts)	Decreased
Maximum total time in system	13.24 minutes	12.62 minutes	Increased
Time-average number of parts in queue	0.79 part	0.79 part	No change
Maximum number of parts in queue	3 parts	3 parts	No change
Drill-press utilization	0.92 (dimensionless proportion)	0.92 (dimensionless proportion)	No change

Exercise 2-5:

Here, we have two spots instead if one, as two undefined spaces for in service arrival times. Departure also were indicated. We need to indicate that after the arrival times of entities on service their entity number to match them up with the correct departure records. The summary of results indicated in the table below:

Performance Measure	Value	Results for table 2-3	Change
total prediction	5 parts	15 parts	No change
average waiting time in queue	0.29 min./part (7 parts)	2.53 min/part (6 parts)	Decreased
maximum waiting time in queue	2.06 minutes	8.16 min.	Decreased
average total time in service	3.52 min./part (5 parts)	6.44 min./part (5 parts)	Decreased
maximum total time in system	6.25 minutes	12.62 minutes	Decreased
Time average, no. if parts in queue	0.10 part	0.79 part	Decreased
maximum no. of parts in queue	1 part	3 parts	Decreased
Drill-press utilization	0.47, E=18.95/(2*20), dimensionless proportion	0.92 (dimensionless proportion)	Decreased

Congestion is considerably on all measures. The average total time in the system reducted, since parts must still endure their processing times no matter how little time they have to wait in queue.