SE4420

Norman Chan

Homework 1

NAVAL POSTGRADUATE SCHOOL

QUESTION 1

(1 point) The length of a queue during a 30 minute period is 3 for the first 5 minutes, 4 for the next 10 minutes, 2 for the next 6 minutes, and 3 for the last 9 minutes. What is the average queue length during this time?

Average Queue Length = 3*(5/30) + 4*(10/30) + 2*(6/30) + 3*(9/30) = 3.1333

QUESTION 2

(4 points) Compute this problem manually without the aid of a simulation tool. A Navy helicopter mechanic starts his shift and services incoming helicopters at the following interarrival times in hours:

[0, 1.4, 2.1, 1.9, 0.2, 1.5]

Thus the first pilot arrives at the very beginning of his shift. The respective helicopter service times in hours are:

[2.2, 1.2, .3, 2.8, .2, 1.8]

Calculate the minimum and maximum queue length for this period, the total queue time (total time spent in queue for all pilots), the average waiting time in queue, the total idle time for the mechanic, and the resource utilization for the mechanic. Show all your work.

I build a table in excel that maps out the start time and end time of each helicopter under maintenance based on the interarrival times and service times. As this is a FIFO queue, the wait time for a subsequent helicopter is the difference between the arrival time and the end time of the previous service, with a floor of 0. Idle time is the difference between arrival time and the previous end time, with a floor of 0.

Helo #	Arrival	Service	Start	End	Q Time	Idle
1	0	2.2	0	2.2	0	0
2	1.4	1.2	2.2	3.4	0.8	0
3	3.5	0.3	3.5	3.8	0	0.1
4	5.4	2.8	5.4	8.2	0	1.6
5	5.6	0.2	8.2	8.4	2.6	0
6	7.1	1.8	8.4	10.2	1.3	0

Homework 1

Total queue time is 4.7 hours. Average queue time is 0.783 hours. Idle time is 1.7 hours. Resource utilization is (Total – Idle)/Total = (10.2 – 1.7)/10.2 = 0.833.

QUESTION 3

(5 points) Below is another depiction of the class example for the Navy cargo ship maintenance facility scenario. This is for the single facility configuration and all time units are in days.

Ship #	Arrival	Service	Start	End
1	0	2.5	0	2.5
2	1		0	0
3	2	2	2.5	4.5
4	3		0	0
5	4	3	4.5	7.5
6	5	1.5	7.5	9
7	6		0	0
8	7	2	9	11
9	8	1	11	12
10	9		0	0
11	10		0	0
12	11		0	0
13	12	2	12	14
14	13		0	0
15	14		0	0
16	15	0.5	15	15.5
17	16		0	0
18	17	1.5	17	18.5
19	18	3	18.5	21.5
20	19		0	0

1) What is the average waiting time for the ships that need service?

2) Calculate the 20-day resource utilization of the single facility using fractional days. The facility is open and staffed 24 hours each day available for service.

Homework 1

Ship #	Arrival	Service	Start	End	Wait Time	Idle Time
1	0	2.5	0	2.5	0	0
3	2	2	2.5	4.5	0.5	0
5	4	3	4.5	7.5	0.5	0
6	5	1.5	7.5	9	2.5	0
8	7	2	9	11	2	0
9	8	1	11	12	3	0
13	12	2	12	14	0	0
16	15	0.5	15	15.5	0	1
18	17	1.5	17	18.5	0	1.5
19	18	3	18.5	21.5	0.5	0

Likewise, generate the table with wait time and idle time, ignoring the ships that do not need maintenance, as they are not taking up queue space for the maintenance crew. The average waiting time is .9 days for the 10 ships that need service. Utilization is 0.875, due to 1.5 idle days out of the 20 day window.

QUESTION 4

(1 point) In Problem 3, how might the resource utilization change for the first facility when a second facility is added? In this case ships will be serviced by the second facility when the first is busy. Assume the same inputs for ship arrivals and service durations.

A. it will be the same

B. it will increase

C. it will decrease

D. it cannot be determined

C - The resource utilization will decrease as the FIFO queue gets decreased with a second processor. This will ultimately increase the idle time for both service crews and drop the overall resource utilization. Using the same model, but having two service teams, the total idle time increases to 20.5 days out of 40 available workdays (2 teams over 20 days). This is a resource utilization of 0.4875.