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Simulation and Modelling

Homework 01

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QUESTION

A small grocery store has only 1 checkout counter, customers arrive at this counter 1 - 6 minutes apart, and each value has the same probability of occurrence, the service time varies from 1-8 minutes, with the given probabilities:

Service Times	Probability
1	0.1
2	0.2
3	0.3
4	0.05
5	0.25
6	0.025
7	0.025
8	0.05

SOLUTION

INTER ARRIVAL TIME

Times	Probability	Cumulative Probability	Assignment of Random No
1	0.166	0.166	0 - 166
2	0.166	0.332	167 - 332
3	0.166	0.498	333 - 498
4	0.166	0.664	499 - 664
5	0.166	0.83	665 - 830
6	0.166	1.00	831 - 1000

SERVICE TIME

Times	Probability	Cumulative Probability	Assignment of Random No
1	0.1	0.1	0 - 10
2	0.2	0.3	11 - 30
3	0.3	0.6	31 - 60
4	0.05	0.65	61 - 65
5	0.25	0.9	66 - 90
6	0.025	0.925	91 - 93

7	0.025	0.95	94 - 95
8	0.05	1	96 - 100

FORMULATED TABLE

Customers	Random No of Inter Arrival Time	Inter Arrival Time	Random No of Service Time	Service Time	Arrival Time	Delay Duration	Departure Time	Time Spent in System
1	904	6	66	5	6	0	11	5
2	285	2	16	2	8	3	13	5
3	23	1	24	2	9	4	15	6
4	34	1	23	2	10	5	17	7
5	217	2	26	2	12	5	19	7
6	921	6	50	3	18	1	22	4
7	9	1	38	3	19	3	25	6
8	959	6	78	5	25	0	30	5
9	907	6	98	8	31	0	39	8
10	540	4	57	3	35	4	42	7
11	599	4	98	8	39	3	50	11
12	925	6	69	5	45	5	55	10
13	294	2	15	2	47	8	57	10
14	136	1	69	5	48	9	62	14
15	8	1	54	3	49	13	65	16
16	346	3	87	5	52	13	70	18
17	137	1	16	2	53	17	72	19
18	910	6	53	3	59	13	75	16
19	508	4	68	5	63	12	80	17
20	584	4	2	1	67	13	81	14

CLOCK TABLE

Clock Time	Type of Event	Server State	Idle Duration of Server	Customers in Queue
0	Initial	0		
6	A1	1		0
8	A2	1		1
9	A3	1		2
10	A4	1		3
11	D1	1		2
12	A5	1		3
13	D2	1		2
15	D3	1		1
17	D4	1		0
18	A6	1		1
19	D5, A7	1		1
22	D6	1		0
25	D7, A8	1		0
30	D8	0		0
31	A9	1	1 (31-30)	0
35	A10	1		1
39	D9, A11	1		1
42	D10	1		0
45	A12	1		1
47	A13	1		2
48	A14	1		3
49	A15	1		4
50	D11	1		3
52	A16	1		4
53	A17	1		5
55	D12	1		4
57	D13	1		3
59	A18	1		4
62	D14	1		3
63	A19	1		4

65	D15	1		3
67	A20	1		4
70	D16	1		3
72	D17	1		2
75	D18	1		1
80	D19	1		0
81	D20	0		0

AVG WAITING TIME FOR CUSTOMERS

PROBABILITY THAT THE CUSTOMER HAS TO WAIT

Customers who Faced Delay / Total Customers

16/20 ➔ 0.8

80% chance that a customer must wait.

PROBABILITY OF IDLE SERVER

Idle time (total) / Total Simulation Time

1/81 ➔ 0.012

1.23% chance that the server will remain idle.

AVERAGE SERVICE TIME

Sum of Service Time / Total Customers

74/20 ➔ 3.7

The average Service Time is 3.7mins.

Using Summation Formula:

(1) (0.1) + (2) (0.2) + (3) (0.3) + (4) (0.05) + (5) (0.25) + (6) (0.025) + (7) (0.025) + (8) (0.05)

143/40

The average Service Time is 3.575mins.

AVERAGE TIME BETWEEN ARRIVALS

Sum of Interarrival Time / Total Customers

67/20

The average time between Arrivals is 3.35mins.

Using Summation Formula:

(1) (0.166) + (2) (0.166) + (3) (0.166) + (4) (0.166) + (5) (0.166) + (6) (0.166)

1743/500

The average time between Arrivals is 3.486mins.