1. Sequence

|  |  |  |
| --- | --- | --- |
| Ci | Ai | Pi |
| 1 | 0 | 2 |
| 2 | 1 | 3 |
| 3 | 1 | 2 |
| 4 | 2 | 5 |
| 5 | 2 | 3 |
| 6 | 6 | 2 |
| 7 | 7 | 2 |
| 8 | 7 | 3 |
| 9 | 9 | 3 |

1. Simulation

**SCENARIOS A:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| T | Arrival | Queue | Cashier | Completed |
| 0 | C1 | C1 | C1 |  |
| 1 | C3 C2 | C2 | C1 |  |
| 2 | C5 C4 | C3 | C2 | C1 |
| 3 | C5 C4 | C3 | C2 | C1 |
| 4 | C5 C4 | C3 | C2 | C1 |
| 5 | C5 | C4 | C3 | C2 C1 |
| 6 | C6 C5 | C4 | C3 | C2 C1 |
| 7 | C8 C7 C6 | C5 | C4 | C3 C2 C1 |
| 8 | C8 C7 C6 | C5 | C4 | C3 C2 C1 |
| 9 | C8 C7 C6 | C5 | C4 | C3 C2 C1 |
| 10 | C8 C7 C6 | C5 | C4 | C3 C2 C1 |
| 11 | C8 C7 C6 | C5 | C4 | C3 C2 C1 |
| 12 | C7 | C6 | C5 | C4 C3 C2 C1 |
| 13 | C7 | C6 | C5 | C4 C3 C2 C1 |
| 14 | C7 | C6 | C5 | C4 C3 C2 C1 |
| 15 |  | C7 | C6 | 12345 |
| 16 |  | C7 | C6 | 12345 |
| 17 |  |  | C7 | 123456 |
| 18 |  |  | C7 | 123456 |
| 19 |  |  |  | 1234567 |

**EVALUATION A**

| Ci | Ai | Si | Pi | Di | Wi | Ti |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | 0 | 0 | 2 | 2 | 0 | 2 |
| 2 | 1 | 2 | 3 | 5 | 1 | 4 |
| 3 | 1 | 5 | 2 | 7 | 4 | 6 |
| 4 | 2 | 7 | 5 | 12 | 5 | 10 |
| 5 | 2 | 12 | 3 | 15 | 10 | 13 |
| 6 | 6 | 15 | 2 | 17 | 9 | 11 |
| 7 | 7 | 17 | 2 | 19 | 10 | 12 |
| 8 |  |  |  |  |  |  |
| 9 |  |  |  |  |  |  |

Percentage of served customers: 7/9

Percentage of customer who had to wait: 6/9

Total waiting time: 39

Average waiting time: 39/7

Maximal waiting time:10

Total service time: 19

Average service time: 19/7

Ratio between average service and waiting time: 19/39 = 0.48

**SCENARIOS B:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| T | Arrival | Queue | Cashier1 | Cashier2 | Completed |
| 0 | C1 | C1 | C1 |  |  |
| 1 | C3 C2 | C2 | C1 |  |  |
| 2 | C5 C4 | C3 | C2 |  | C1 |
| 3 | C5 C4 | C3 | C2 |  | C1 |
| 4 | C5 C4 | C3 | C2 |  | C1 |
| 5 | C5 | C4 | C3 |  | C2 C1 |
| 6 | C6 C5 | C4 | C3 |  | C2 C1 |
| 7 | C8 C7 C6 | C5 | C4 |  | C3 C2 C1 |
| 8 | C8 C7 C6 | C5 | C4 |  | C3 C2 C1 |
| 9 | C9C8 C7 | C6 | C4 | C5 | C3 C2 C1 |
| 10 | 987 | 6 | 4 | 5 | 321 |
| 11 | 987 | 6 | 4 | 5 | 321 |
| 12 | 98 | 7 | 6 | 5 | 4321 |
| 13 | 9 | 8 | 6 | 7 | 54321 |
| 14 |  | 9 | 8 | 7 | 654321 |
| 15 |  |  | 8 | 9 | 7654321 |
| 16 |  |  | 8 | 9 | 7654321 |
| 17 |  |  |  | 9 | 87654321 |
| 18 |  |  |  |  | 987654321 |

**EVALUATION B**

| Ci | Ai | Si | Pi | Wi |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | 0 | 0 | 2 | 0 |  |  |
| 2 | 1 | 2 | 3 | 1 |  |  |
| 3 | 1 | 5 | 2 | 4 |  |  |
| 4 | 2 | 7 | 5 | 5 |  |  |
| 5 | 2 | 9 | 3 | 7 |  |  |
| 6 | 6 | 12 | 2 | 6 |  |  |
| 7 | 7 | 13 | 2 | 6 |  |  |
| 8 | 7 | 14 | 3 | 7 |  |  |
| 9 | 9 | 15 | 3 | 6 |  |  |

Percentage of served customers: 9/9

Percentage of customer who had to wait: 8/9

Total waiting time: 42

Total service time: 25

Ratio between average service and waiting time: 25/42 = 0.59

**SCENARIOS C:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| T | Arrival | Queue | Cashier1 | Cashier2 | Completed |
| 0 | C1 | C1 | C1 |  |  |
| 1 | C3 C2 | C3 | C1 | C2 |  |
| 2 | C5 C4 | C4 | C3 | C2 | C1 |
| 3 | 5 | 4 | 3 | C2 | 1 |
| 4 |  |  | 4 | 5 | 321 |
| 5 |  |  | 4 | 5 | 321 |
| 6 | C6 | 6 | 4 | 5 | 321 |
| 7 | 78 | 7 | 4 | 6 | 5321 |
| 8 |  |  | 4 | 6 |  |
| 9 | 9 |  | 8 | 7 | 654321 |
| 10 |  |  | 8 | 7 |  |
| 11 |  |  | 8 | 9 |  |
| 12 |  |  |  | 9 | 987654321 |
| 13 |  |  |  | 9 |  |
| 14 |  |  |  |  | 987654F321 |

**EVALUATION C**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Ci | Ai | Si | Pi | Wi |  |  |
| 1 | 0 | 0 | 2 | 0 |  |  |
| 2 | 1 | 1 | 3 | 0 |  |  |
| 3 | 1 | 2 | 2 | 1 |  |  |
| 4 | 2 | 4 | 5 | 2 |  |  |
| 5 | 2 | 4 | 3 | 2 |  |  |
| 6 | 6 | 7 | 2 | 1 |  |  |
| 7 | 7 | 9 | 2 | 2 |  |  |
| 8 | 7 | 9 | 3 | 2 |  |  |
| 9 | 9 | 12 | 3 | 3 |  |  |

Percentage of served customers: 9/9

Percentage of customer who had to wait: 7/9

Total waiting time: 13

Total service time: 25

Ratio between average service and waiting time: 25/13 = 1.9

**SCENARIOS D:**

| T | Arrival | Queue1 | Cashier1 | Queue2 | Cashier2 | Completed |
| --- | --- | --- | --- | --- | --- | --- |
| 0 | C1 | C1 | C1 |  |  |  |
| 1 | C3 C2 | C3 | C1 | C2 | C2 |  |
| 2 | C5 C4 | C4 | C3 | C5 | C2 | C1 |
| 3 |  | 4 | 3 |  | C2 | 1 |
| 4 |  |  | 4 |  | 5 | 321 |
| 5 |  |  | 4 |  | 5 | 321 |
| 6 | C6 | 6 | 4 |  | 5 | 321 |
| 7 | 78 | C8 | 4 | C7 | 6 | 5321 |
| 8 |  |  | 4 |  | 6 |  |
| 9 | 9 |  | 8 | C9 | 7 | 654321 |
| 10 |  |  | 8 |  | 7 |  |
| 11 |  |  | 8 |  | 9 |  |
| 12 |  |  |  |  | 9 | 987654321 |
| 13 |  |  |  |  | 9 |  |
| 14 |  |  |  |  |  | 987654F321 |

**EVALUATION D**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Ci | Ai | Si | Pi | Wi |  |  |
| 1 | 0 | 0 | 2 | 0 |  |  |
| 2 | 1 | 1 | 3 | 0 |  |  |
| 3 | 1 | 2 | 2 | 1 |  |  |
| 4 | 2 | 4 | 5 | 2 |  |  |
| 5 | 2 | 4 | 3 | 2 |  |  |
| 6 | 6 | 7 | 2 | 1 |  |  |
| 7 | 7 | 9 | 2 | 2 |  |  |
| 8 | 7 | 9 | 3 | 2 |  |  |
| 9 | 9 | 12 | 3 | 3 |  |  |

Percentage of served customers: 9/9

Percentage of customer who had to wait: 7/9

Total waiting time: 13

Total service time: 25

Ratio between average service and waiting time: 25/13 = 1.9