# Question

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

## Tables

### Inter ARrival TImes

|  |  |  |  |
| --- | --- | --- | --- |
| **Times** | **Probability** | **C.P** | **Random Number Range** |
| 1 | 0.125 | 0.125 | 0 - 125 |
| 2 | 0.125 | 0.25 | 126 - 250 |
| 3 | 0.125 | 0.375 | 251 - 375 |
| 4 | 0.125 | 0.5 | 376 - 500 |
| 5 | 0.125 | 0.625 | 501 - 625 |
| 6 | 0.125 | 0.75 | 626 - 750 |
| 7 | 0.125 | 0.875 | 751 - 875 |
| 8 | 0.125 | 1 | 876 - 1000 |

### Service Times

|  |  |  |  |
| --- | --- | --- | --- |
| **Times** | **Probability** | **C.P** | **Random Number Range** |
| 1 | 0.1 | 0.1 | 0 - 10 |
| 2 | 0.2 | 0.3 | 11 - 30 |
| 3 | 0.3 | 0.6 | 31 - 60 |
| 4 | 0.25 | 0.85 | 61 - 85 |
| 5 | 0.1 | 0.95 | 86 - 95 |
| 6 | 0.05 | 1 | 96 - 100 |

### Formulated TAble

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Customer** | **Random No of I.A** | **Inter Arrival** | **Random No of S.T** | **Service Time** | **Arrival Time** | **Delay Duration** | **Depart Time** | **Time Spent in System** |
| 1 | 870 | 7 | 23 | 2 | 7 | 0 | 9 | 2 |
| 2 | 758 | 7 | 82 | 4 | 14 | 0 | 18 | 4 |
| 3 | 364 | 3 | 33 | 3 | 17 | 1 | 21 | 4 |
| 4 | 314 | 3 | 64 | 4 | 20 | 1 | 25 | 5 |
| 5 | 320 | 3 | 92 | 5 | 23 | 2 | 30 | 7 |
| 6 | 587 | 5 | 8 | 1 | 28 | 2 | 31 | 3 |
| 7 | 433 | 4 | 10 | 1 | 32 | 0 | 33 | 1 |
| 8 | 663 | 6 | 86 | 5 | 38 | 0 | 43 | 5 |
| 9 | 1 | 1 | 6 | 1 | 39 | 4 | 44 | 5 |
| 10 | 802 | 7 | 91 | 5 | 46 | 0 | 51 | 5 |

### Clock Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Clock Time** | **Type of Event** | **State** | **Idle Duration** | **Customer in Queue** |
| 0 | Initialize | 0 | - | 0 |
| 7 | A1 | 1 | 7 | 0 |
| 9 | D1 | 0 | - | 0 |
| 14 | A2 | 1 | 5 | 0 |
| 17 | A3 | 1 | - | 1 |
| 18 | D2 | 1 | - | 0 |
| 20 | A4 | 1 | - | 1 |
| 21 | D3 | 1 | - | 0 |
| 23 | A5 | 1 | - | 1 |
| 25 | D4 | 1 | - | 0 |
| 28 | A6 | 1 | - | 1 |
| 30 | D5 | 1 | - | 0 |
| 31 | D6 | 0 | - | 0 |
| 32 | A7 | 1 | 1 | 0 |
| 33 | D7 | 0 | - | 0 |
| 38 | A8 | 1 | 5 | 0 |
| 39 | A9 | 1 | - | 1 |
| 43 | D8 | 1 | - | 0 |
| 44 | D9 | 0 | - | 0 |
| 46 | A10 | 1 | 2 | 0 |
| 51 | D10 | 0 | - | 0 |

# 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 | C.P | Random No Range |
| 1 | 0.166 | 0.166 | 001 - 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 | C.P | Random No Range |
| 1 | 0.1 | 0.1 | 1 - 100 |
| 2 | 0.2 | 0.3 | 101 - 300 |
| 3 | 0.3 | 0.6 | 301 - 600 |
| 4 | 0.05 | 0.65 | 601 - 650 |
| 5 | 0.25 | 0.9 | 651 - 900 |
| 6 | 0.025 | 0.925 | 901 - 925 |
| 7 | 0.025 | 0.95 | 926 - 950 |
| 8 | 0.05 | 1.00 | 951 - 1000 |

### Formulated Table

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Customers | Random I. A | Inter Arrival | Random S. T | Service Time | Arrival Time | Delay Duration | Departure Time | Time in System |
| 1 | 075 | 1 | 638 | 4 | 1 | 0 | 5 | 4 |
| 2 | 196 | 2 | 101 | 2 | 3 | 2 | 7 | 4 |
| 3 | 334 | 3 | 005 | 1 | 6 | 1 | 8 | 2 |
| 4 | 517 | 4 | 175 | 2 | 10 | 0 | 12 | 2 |
| 5 | 901 | 6 | 469 | 3 | 16 | 0 | 19 | 3 |
| 6 | 847 | 6 | 517 | 3 | 22 | 0 | 25 | 3 |
| 7 | 063 | 1 | 411 | 3 | 23 | 2 | 28 | 5 |
| 8 | 411 | 3 | 532 | 3 | 26 | 2 | 31 | 5 |
| 9 | 106 | 1 | 950 | 8 | 27 | 4 | 39 | 12 |
| 10 | 506 | 4 | 556 | 3 | 31 | 8 | 42 | 11 |

### Clock Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Clock Time | Type of Event | Server Status | Idle time of Server | Customers in Queue |
| 0 | Initial | 0 |  | 0 |
| 1 | A1 | 1 | 1 | 0 |
| 3 | A2 | 1 |  | 1 |
| 5 | D1 | 1 |  | 0 |
| 6 | A3 | 1 |  | 1 |
| 7 | D2 | 1 |  | 0 |
| 8 | D3 | 0 |  | 0 |
| 10 | A4 | 1 | 2 | 0 |
| 12 | D4 | 0 |  | 0 |
| 16 | A5 | 1 | 4 | 0 |
| 19 | D5 | 0 |  | 0 |
| 22 | A6 | 1 | 3 | 0 |
| 23 | A7 | 1 |  | 1 |
| 25 | D6 | 1 |  | 0 |
| 26 | A8 | 1 |  | 1 |
| 27 | A9 | 1 |  | 2 |
| 28 | D7 | 1 |  | 1 |
| 31 | A10, D8 | 1 |  | 1 |
| 39 | D9 | 1 |  | 0 |
| 42 | D10 | 0 |  | 0 |

# Question - Double Queue (Able Baker)

### Inter Arrival Time

|  |  |  |  |
| --- | --- | --- | --- |
| Times | Probability | C.P | Range |
| 1 | 0.25 | 0.25 | 1 - 25 |
| 2 | 0.40 | 0.65 | 26 - 65 |
| 3 | 0.20 | 0.85 | 66 - 85 |
| 4 | 0.15 | 1.00 | 86 - 100 |

### Service Time Able

|  |  |  |  |
| --- | --- | --- | --- |
| Times | Probability | C.P | Range |
| 2 | 0.30 | 0.30 | 1 - 30 |
| 3 | 0.28 | 0.58 | 31 - 58 |
| 4 | 0.25 | 0.83 | 59 - 83 |
| 5 | 0.17 | 1.00 | 84 - 100 |

### Service Time Baker

|  |  |  |  |
| --- | --- | --- | --- |
| Times | Probability | C.P | Range |
| 3 | 0.35 | 0.35 | 1 - 35 |
| 4 | 0.25 | 0.60 | 36 - 60 |
| 5 | 0.20 | 0.80 | 61 - 80 |
| 6 | 0.20 | 1.00 | 81 - 100 |

### Formulated Table

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Customer | Random I. A | Inter Arrival | | Random S. T | | Service Time (Able) | Service Time (Baker) | Arrival Time | Delay Time | Departure Time | Time in System |
| 1 | 26 | 2 | 95 | | 5 | | - | 2 | 0 | 7 | 5 |
| 2 | 98 | 4 | 21 | | - | | 3 | 6 | 0 | 9 | 3 |
| 3 | 90 | 4 | 51 | | 3 | | - | 10 | 0 | 13 | 3 |
| 4 | 26 | 2 | 92 | | - | | 6 | 12 | 0 | 18 | 6 |
| 5 | 42 | 2 | 38 | | 3 | | - | 14 | 0 | 17 | 3 |