**Task 1: Job Shop Model**

Average Total Delay in Queue for Each Job Type

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Job 1 --> 0.9802

Job 2 --> 0.3431

Job 3 --> 1.104

Overall Average Job Total Delay: **0.6864**

Average Number in Each queue

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Station 1 Queue --> 1.016

Station 2 Queue --> 3.2938

Station 3 Queue --> 0.0745

Station 4 Queue --> 0.3531

Station 5 Queue --> 0.2903

Average Number of Jobs in the Whole System: **12.8379**

Average Delay in Queue for Each Station

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Station 1 Queue --> 0.3114

Station 2 Queue --> 1.3169

Station 3 Queue --> 0.0246

Station 4 Queue --> 0.1567

Station 5 Queue --> 0.1912

**Note:** We can see that average delay of the queue in station 2 is larger than the other station’s queue. So, the bottleneck is on the station 2. So, extra machine is needed in station 2.

**Task 2: Cafeteria Model**

**Base Case (4 Employees):**

Avg. and Max Delay in queue:

|  |  |  |
| --- | --- | --- |
| **Counter Name** | **Avg. Delay(min)** | **Max Delay(min)** |
| Hot Food | 36.947 | 4058.046 |
| Speciality Sandwich | 9.297 | 1258.387 |
| Cashier | 0.001 | 9.003 |

Time Avg. and Max number in queue:

|  |  |  |
| --- | --- | --- |
| **Counter Name** | **Time Avg.** | **Max** |
| Hot Food | 108.059 | 217 |
| Speciality Sandwich | 5.994 | 16 |
| Cashier | 0.001 | 1 |

Avg. and Max delay for each type of customers:

|  |  |  |
| --- | --- | --- |
| **Customer Type** | **Avg. Delay(min)** | **Max Delay(min)** |
| Type 1(hot food->drinks->cash) | 8.182 | 67.634 |
| Type 2(sandwich->drinks->cash) | 6.851 | 20.973 |
| Type 3(drinks->cash) | 0.0 | 0.0 |

Overall Avg. Delay = **7.573 min**

Average No. of Customers in the System: **116.811**

Max No. of Customers in the System: **235**

Total Customer served:  **119**

**5 Employees Combinations:**

1. Hot Food: 1, Sandwich:1, Cashier: 3

* Overall Avg. Delay: **7.572 min**
* Total Customer Served: **119**

1. Hot Food: 2, Sandwich:1, Cashier: 2

* Overall Avg. Delay: **10.357 min**
* Total Customer Served: **179**

1. Hot Food: 1, Sandwich:2, Cashier: 2

* Overall Avg. Delay: **6.036 min**
* Total Customer Served: **127**

**6 Employees Combinations:**

1. Hot Food: 2, Sandwich: 2, Cashier: 2
   * Overall Avg. Delay: **8.466 min**
   * Total Customer Served: **191**
2. Hot Food: 2, Sandwich: 1, Cashier: 3
   * Overall Avg. Delay: **10.212 min**
   * Total Customer Served: **181**
3. Hot Food: 1, Sandwich: 2, Cashier: 3
   * Overall Avg. Delay: **6.036 min**
   * Total Customer Served: **127**

**7 Employees:**

1. Hot Food:2, Sandwich: 2, Cashier: 3
   * Overall Avg. Delay: **8.509 min**
   * Total Customer Served: **203**

Considering the Overall Avg. Delay, we can see that the value if lowest on the combinations:

1. [ Hot food:1, Sandwich: 2, Cashier: 2] (6.036 min)

2. [ Hot food:1, Sandwich: 2, Cashier: 3] (6.036 min)

Considering the Total Customer Served, we can see that the value is highest on the combination:

[ Hot food:2, Sandwich: 2, Cashier: 3]. (serves 203 customers)

[2,2,3] combination’s overall Avg. delay is 2.473 min larger than the lowest Avg. delays. But it serves more customers than any other combinations. So, the recommended employee combination is:

* + **Hot food:2, Sandwich: 2, Cashier: 3**