MBA643A: Simulation Of Business Systems

Report: Supply Chain System

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INTRODUCTION: SUPPLY CHAIN SYSTEM

A supply chain system, or simply "supply chain," is a network that facilitates the movement of parties engaged in a product life cycle, from manufacturing to selling (Simchi-Levi et al. [2003]). Nodes and arcs make up such a network. Nodes stand in for suppliers, manufacturers, distributors, and vendors (such as retail outlets), as well as their inventory facilities for holding goods and transportation facilities for moving them between nodes. Arcs show the connections between the nodes along which commodities are moved using various means (trucking, railways, airways, and so on).

PROBLEM STATEMENT

Consider a production/inventory system where the production process (e.g., packaging) is comprised of three stages:

1. Filling each container unit (e.g., bottles)
2. Sealing each unit
3. Placing labels on each unit

The production process is fueled by a raw material storage source, and units of the finished product (units, for short) are kept in a warehouse. Customers bring product needs (requests) to the warehouse, and if a demand cannot be fully met by inventory on hand, the unfulfilled portion constitutes a lost sale.

Design and simulate effective and efficient supply chain operations that meet customer expectations.

PERFORMANCE MEASURES

NOTE: The results in the report reflect the simulation that is run for 10 replications, with each replication of 800 hours.

Production Process Utilization = 70.99 %

Downtime Probability of Production facility =

The production process utilization = 70.24%
The IDLE probability = 1-0.9891 = 0.0109
Therefore, the downtime = (1-0.7024-0.0109)*100
= 0.2867 * 100
= 28.67%

Average inventory level at the warehouse = 187.68

Percentage of customers whose demand is not completely satisfied

Customer Lost = 9.3911 (on average for 10 replications)
Total Customers = 82.7923 (on average for 10 replications)
% customers whose demand is not satisfied = 9.3911*100/82.7923
= 11.34%

Average lost demand quantity, given that it is not completely satisfied

Amount lost = 208.80 demands
Customers lost = 9.3911
Average demand lost per customer = 208.80/9.3911 = 22.23

Also, there is a growing consensus that the inter-arrival times between successive customers are not IID Uniform, instead it is IID Exponential with a mean of 5 hours. If that is so, how will the five performance measures be impacted?

Production Process Utilization = 69.98 %

Downtime Probability of Production facility =

The production process utilization = 69.98%
The IDLE probability = 1-0.9903 = 0.0097
Therefore, the downtime = (1-0.6998-0.0097)*100
= 0.2905 * 100
= 29.05%

Average inventory level at the warehouse = 183.23

Percentage of customers whose demand is not completely satisfied

Customer Lost = 7.5271 (on average for 10 replications)
Total Customers = 78.9001 (on average for 10 replications)
% customers whose demand is not satisfied = 7.5271*100/78.9001
= 9.54%

Average lost demand quantity, given that it is not completely satisfied

Amount lost = 142.70 demands
Customers lost = 7.5271
Average demand lost per customer = 142.7/7.5271 = 18.96

Appropriate time study was conducted on all three processes and it was found that the mean of the process remains at 15 minutes, whereas the standard deviation varies as per process and as well as processing time distribution. How will the system perform, if the individual production process times are following the pattern given below?

- **Filling each container unit (e.g., bottles) - Uniform (5, 7)**

- **Sealing each unit - Normal (4, 1)**
- **Placing labels on each unit - Triangular (3, 5, 8)**

Production Process Utilization = 72.86 %

Downtime Probability of Production facility =

The production process utilization = 72.86%
The IDLE probability = 1-0.9896 = 0.104
Therefore, the downtime = (1-0.7286-0.104)*100
= 16.74%

Average inventory level at the warehouse = 202.36

Percentage of customers whose demand is not completely satisfied

Customer Lost = 6.3549 (on average for 10 replications)
Total Customers = 80.5173 (on average for 10 replications)
% customers whose demand is not satisfied = 6.3549*100/80.5173
= 7.89%

Average lost demand quantity, given that it is not completely satisfied

Amount lost = 132.20 demands
Customers lost = 6.3549
Average demand lost per customer = 132.20/6.3549 = 20.80
