MBA643A: Mini Simulation Exercise - 1

Consider a generic packaging line for some product, such as a pharmaceutical plant producing a packaged medicinal product, or a food processing plant producing packaged foods or beverages. The line consists of workstations that perform the processes of filling, capping, labeling, sealing, and carton packing. Individual product units will be referred to simply as units.

The following assumptions are in place about the system:

- The filling workstation always has material in front of it, so that it never starves
- The buffer space between workstations can hold at most five units.
- A workstation gets blocked if there is no space in the immediate downstream buffer (manufacturing blocking).

From the discussions with the management, it is worthwhile to elaborate and analyze the behavior of the packaging line under study. The first workstation (filling) drives the system in that it feeds all downstream workstations with units. Clearly, one of the workstations in the line is the slowest (if there are several slowest workstations, we take the first among them). The throughput (output rate) of that workstation then coincides with the throughput of the entire packaging line. Furthermore, workstations upstream of the slowest one will experience excessive buildup of WIP inventory in their buffers. In contrast, workstations downstream of the slowest one will always have lightly occupied or empty WIP inventory buffers. Thus, the slowest workstation acts as a bottleneck in the packaging line.

There is no reliable data available for the packaging facility. Hence, the base case is taken where the processing times for filling, capping, labeling, sealing, and carton packing are 6.5, 5, 8, 5, and 6 minutes, respectively. These times are considered as deterministic to begin with.

Arrival data is also not available, and for initial analysis, a deterministic case was given when 30 arrivals happen at the beginning of the shift (all at the same time) and the system is done until all 30 units have completed processing and has left the system.

Using the base case, answer the following.
1. Order the machines in descending format with respect to their utilization. The top most machine will be the bottleneck.
2. If arrivals were to happen one at a time, and time between arrivals follow exponential distribution (so that arrival process is Poisson), what should be the mean TBA if no machine should be blocked while maintaining the maximum throughput.

Now, you have to study the variability in the system. It is suggested that both 10% and 20% variability on the deterministic time values is should be studied to model the variability in the system. However, the processing time distributions could be either following uniform or normal (all processes will follow the same distribution). Hence, using the mean TBA value identified by you in the base case, analyze the system and suggest which distribution of the processing times is better. When you are analyzing the variability, it is expected that you will simulate the system for a large number of arrivals and not limited to the 30 arrivals. Provide a short management presentation of your findings.