Alexandria University
Faculty of Engineering
Computer and Systems Engineering Dept.
Fourth Year
Spring 2012

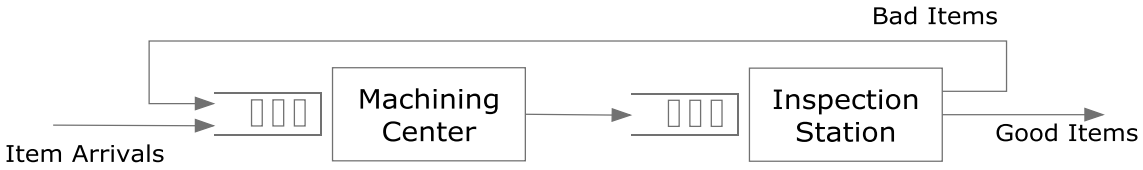
CS433: Performance Evaluation
Assignment 2
Assigned: Tuesday, April 10th, 2012
Due: To be determined

Factory Simulation

Objectives

Upon completion of this assignment, you will be able to apply basic simulation techniques to analyze and evaluate the performance of a certain model.

Model Description [1]



A small factory consists of a machining center and inspection station in series as shown in the above figure. Unfinished parts arrive at the factory with exponential interarrival times with a mean of 1 minute. Processing times at the machining center are uniform on the interval [0.65, 0.70] minute, and subsequent inspection times are uniformly distributed as [0.75, 0.80] minute. Ten percent of the parts are bad and are sent back to the machine for rework (i.e. 90% of the inspected parts are good and are sent to shipping). You can assume infinite capacity for the queues of the above two modules.

The machining center is subject to randomly occurring breakdowns. In particular, a new (or a freshly-repaired) machine will break down after an exponential amount of time with a mean of 6 hours. Repair times are uniform on the interval [8, 12] minutes. If a part is being processed when the machine breaks down, then the machine continues where it left off upon the completion of repair. Assume the factory is initially empty and idle, and is working continuously without any breaks periods.

[1] Source: Averill M. Law. 1990. Design and analysis of simulation experiments for manufacturing applications (tutorial session). In *Proceedings of the 22nd conference on Winter Simulation* (WSC' 90), Osman Balci (Ed.). IEEE Press, Piscataway, NJ, USA, 33-37.

Specifications

You are required to simulate the factory described earlier according to the following specifications:

1- Implement an LCG random number generator, justifying the selection of the parameters (Jain: section 26.2). Draw the histogram of 100,000 generated numbers. Test the uniformity of your generator using chi-square test (Jain: section 27.1).

2- Implement an exponential random deviate using the inverse transformation technique (Jain: section 28.1).

3- Simulate the above problem as discussed in class (Check Harry Perros, Chapter 1).

4- Your program should output the following:
   a. Inter-arrival times at both queues.
   b. Service times at both centers.
   c. Total items' response times.
   d. Queues lengths (see Jain: section 25.4).
   e. Hourly throughput (Number of items sent for shipping per hour).

   Plot queues lengths and hourly throughput with time.

5- Using a spreadsheet program, draw the histogram and calculate the average, the standard deviation and 90% confidence interval of the above metrics.
   Note: You are only required to calculate the average for the queues lengths.

6- Apply the initial data deletion and moving average of independent replications methods for transient removal to the hourly throughput. (Jain: section 25.3)
   Adjust the stopping criteria at step 3 (justify your selection).

7- Repeat the simulation 10 times (replications) with the stopping criteria adjusted at step 6.

8- Repeat the analysis of step 5 after removing the transient period and using the variance estimation technique of independent replications (Jain: section 25.5).

Delivery

You are required to submit a report that describes your work precisely and showing the results of the simulation. Specific details on the delivery will be determined later.

Policies

- ✓ Late submission is allowed for one week only.
- ✓ Student groups: You should work in groups of two or three students.
- ✓ Delivering a copy will be severely penalized for both parties, so delivering nothing is so much better than delivering a copy.