ICA 14: Cycle-Time Estimation

ISE 453: Design of PLS Systems **Fall 2018**

This ICA has three questions. Questions 1 and 3 should be submitted.

$$t_{CT} = \underbrace{\left(\frac{c_a^2 + c_e^2}{2}\right)\left[\frac{u^{\left(\sqrt{2(m+1)}-1\right)}}{m(1-u)}\right] t_e}_{\text{queuing time}} + \underbrace{t_e}_{\text{process time}}, \quad c_a^2 = \frac{\sigma_a^2}{t_a^2}, \quad t_a = \frac{1}{r_a}$$

$$c_e^2 = c_0^2 + (1 + c_r^2) A(1-A)\frac{MTTR}{t_0}, \quad c_0^2 = \frac{\sigma_0^2}{t_0^2}, \quad c_r^2 = \frac{\sigma_r^2}{MTTR^2}$$

1. If the arrival rate to a workstation is 20 per hour:
   (a) What is the expected number of hours between each arrival?
   (b) If the time between each arrival is always exactly the same, what is the arrival SCV?
   (c) If the interarrival time is totally random, what is the arrival SCV?
   (d) If the interarrival time is totally random, what is its variance?
   (e) If the standard deviation of the interarrival time is five minutes, what is the arrival SCV?

2. Using your throughput feasible spreadsheet from the previous ICA, create a cycle time feasible spreadsheet containing a worksheet that duplicates Table 4.4 in the notes (Cycle Time and Total Machine Cost Estimation slide). In order to check if your worksheet is working correctly, you should increase the throughput from 10 to 11 units per hour. The total cycle time for the line should decrease to 2.191101 hours and the total line cost should increase to $194,000.

3. The desired output rate from a workstation is 120 nondefective units per 8-hr shift, the average time between arrivals is expected to be totally random, it takes on average 12 minutes to process each unit, the standard deviation of the processing time is equal to the average processing time, the yield fraction of the machines is 0.80, with a mean time to failure of 20 hours, and a mean and variance of the repair time of 2 hours and 10 hours squared, respectively.
   (a) What is the expected average cycle time associated with minimizing the number of machines required at the workstation?
   (b) How many units, on average, will be on the machines of the workstation being processed?
   (c) What is the effective capacity (in units per hour) of the workstation?