Assignment 16 - M/D/1

1 Problem

Metropolitan Collection Company (MCC) garbage trucks currently wait an average of 6 minutes each trip before being able to dump their load. MCC is considering hauling to a different collection center at an extra cost of $8 per trip for each truck. The new center can process the loads at a constant rate of 30 units per hour. Arrivals at the new center will be Poisson-distributed, with an average rate of 24 loads per hour. The system is a single-channel, single-phase system with unlimited queue length. If waiting time for the trucks is valued at $200 per hour, how much of a savings per hour would result?

2 Solution

We can model the system of the other collection center like a M/D/1 queue with $\lambda = 24$, $\mu = 30$ and so $\rho = 0.8$. We can compute the main performance measures:

$$W_q = \frac{1}{2}\frac{\rho}{\mu - \lambda} = \frac{1}{2} \times \frac{0.8}{6} = 0.07 \tag{1}$$

$$W = W_q + \frac{1}{\mu} = 0.07 + 0.03 = 0.1 \tag{2}$$

$$L_q = \frac{1}{2}\frac{\rho\lambda}{\mu - \lambda} = 1.6 \tag{3}$$

$$L = L_q + \rho = 2.4 \tag{4}$$

So we have a cost $C = L \times 8 + W \times 200 = 39.2$ If we consider an arrival rate of 24 also for the initial center, we obtain a $\rho \geq 1$, so it is unstable