Assignment 17 - Queue

1 Problem

A company repairs broken machines arriving on average of three per hour and the breakdowns are distributed in a Poisson manner. Downtime costs the company \$25/hour per machine and each worker gets \$4 per hour. One worker can service machines at an average rate of 5 per hour, distributed exponentially. Two workers working together can service 7 per hour, distributed exponentially. Finally, a team of three workers can do 8 per hour, distributed exponentially. What is the optimal (total minimum cost) maintenance crew size for repairing the machines?

2 Solution

We can model the system with M/M/1 queue. In this way we can compute the waiting time in the system for each group of worker through

$$W = \frac{\lambda}{\mu(\mu - \lambda)} \tag{1}$$

So we have $W_1 = 0.3$, $W_2 = 0.1$, $W_3 = 0.075$. The cost will be $C_1 = W_1 \times (25 + 4) = 8.7$, $C_2 = W_2 \times (25 + 8) = 3.3$, $C_3 = W_3 \times (25 + 12) = 2.78$. These are the costs for a single piece, so we can compute $L_1 = 1.5$, $L_2 = 0.75$ and $L_3 = 0.6$ and after the product we obtained that the best group is formed by 3 workers