Prescriptive Analytics - HW 6

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1. Reading completed

2. Arrival rate (λ): 5 cars/hr
   Service time per car ($1/\mu$): 6 mins
   Service rate (μ): 10 cars/hr

   L_s $= \lambda / (\mu - \lambda)$
   $= 5 / (10-5)$
   $= 1$

   The number of cars in the queue is 0.5 per hour which is less than 4 cars per hour. The number of cars in the system is 1 per hour which is also less than 4 cars per hour. Because of this, there will never be a car parked in the no-parking area, so no cars would be fined.

3. Arrival rate (λ): 20 customers/hr
   Service time per car ($1/\mu$): 2 mins/customer
   Service rate (μ): 30 customers/hr

   a. $P(T \leq 3) = 1 - e^{-2(3)} = 0.9975$
      $P(T \leq 6) = 1 - e^{-2(6)} = 0.9999$

      $P(T \leq 6) - P(T \leq 3) = 0.0024$

   b. Noontime arrival rate (λ): 60/2.5 = 24 customers/hr

      $P_{>5}$ $= e^{(\lambda - \mu)t}$
      $= e^{(24-30)(5/60)}$
      $= 0.60653$

      $P_{<5}$ $= 1 - P_{>5}$
      $= 1 - 0.60653$

$= 0.39347$

$0.39347 = 1 - e^{-5\mu}$

$\mu = 90/60$

$= 1.5$ mins/customer

4. Arrival rate (λ): 17 flights/hr
   Service time per flight ($1/\mu$): 3 mins/flight
   Service rate (μ): 20 flights/hr

   Average fuel consumption for flight in air = 10 liters/min
   Fuel cost = $20/liter

   a. $L_q = \lambda^2 / [\mu(\mu-\lambda)]$
      $= 17^2 / [20(20-17)]$
      $= 289 / (20*3)$
      $= 4.8167$ flights

      On average, there are 4.82 flights waiting for permission to land.

   b. $W_q = L_q / \lambda$
      $= 4.8167 / 17$
      $= 0.2833$ hrs / flight

      On average, the fuel cost for the flight waiting to land
      = (0.2833*60)*(10*$20)
      = $3399.60

   c. $P_{<n} = 1 - P_{>n}$
      $= 1 - \rho^{n+1}$
      $= 1 - (17/20)^4$
      $= 0.4779$

   d. $\rho = \lambda / \mu$
      $= 0.85$

5. Arrival rate (λ): 3 letters/hr
   Service rate (μ): 4 letters/hr

a. One secretary: W_s $= 1 / (4-3)$
$= 1$ hr

Pooled Secretaries $= 1 / (8-6)$
$= 0.5$ hrs

The Professors would benefit by pooling the secretaries.

b. It reduces the wait time significantly for Professor A & B, thus allowing their secretaries to become more efficient.