SPRINT 4 DELIVERABLES 11/10/2020

1).  BULB PROBLEM

* EXPECTED LIFE TIME = 2,000 H $E[X] = 2{,}000\,H$ $\lambda = 1/2{,}000$

* P(THAT 2 BULBS SURVIVE MORE THAN 3,000 H)

BULB 1 → $P(X \geq 2{,}000 + 1{,}000 \mid X > 2{,}000)$

↳ $e^{-\lambda s} \Rightarrow e^{-1/2{,}000 \cdot 3{,}000} \Rightarrow e^{-3/2} = \cancel{0.\ldots}$

$= e^{-2/3} \Rightarrow 0.223130$

∴ BECAUSE THE BULBS ARE INDEPENDENT, AND THE MEMORY-LESS PROPERTY

$P(\text{2 BULBS SURVIVE OVER } 3{,}000\,H) = P(\text{A BULB SURVIVES } 3{,}000)^2$

$P(X \geq 3{,}000 \mid X > 2{,}000) = 0.223130$

$(0.223130)^2 = \cancel{0.0\ldots}\ 0.04978 \Rightarrow \underline{0.04978}$

2). FIND PROBABILITY THAT BOTH BULBS REACH 3,000 HOURS

$BULB_1$ → OPERATING FOR 1,000 H → $P(X \geq t+s \mid P > t) \Rightarrow e^{-\lambda t}$

$BULB_2$ → OPERATING FOR 2,500 H → $P(X \geq t+s \mid P > t) \Rightarrow e^{-\lambda t}$

- $P(\text{BULB 1 REACHES } 3{,}000\,H) = e^{-(1/2000) \cdot 2{,}000}$ ← REMAINING TIME TO REACH 3,000 H

↳ $= e^{-2{,}000/2{,}000} = e^{-1}$

- $P(\text{BULB 2 REACHES } 3{,}000\,H) = e^{-(1/2{,}000) \cdot 500} \Rightarrow e^{-(5/20)}$

- $P(\text{BULB 1 AND BULB 2 REACH } 3{,}000\,H) = e^{-1} \cdot e^{-5/20}$

$= e^{-1+(-5/20)} = \underline{0.2865}$

3) **CHECK MY MATH :**

GIVEN :

- AVERAGE TIME FOR DISK = 5 ms
- AVERAGE NUMBER OF DISKS / JOB = 2
- NUMBER OF JOBS IN THE SYSTEM = 120
- AVERAGE RESIDENCE TIME = 1 SEC.

* WE HAVE TO TAKE INTO ACCOUNT THE ~~AVA~~ AVERAGE TIME IT TAKES TO ACCESS EACH DISK

↳ AVERAGE JOB NEEDS TO ACCESS BOTH DISKS

∴ 1 DISK ACCESS = 0.05 s

2 DISK ACCESS = (0.05) * 2 = 0.01

* $\bar{N} = 120$ JOBS λ => $\bar{R}/\bar{N} = 120$ CUST/SEC } PREVIOUS ASSUMPTION

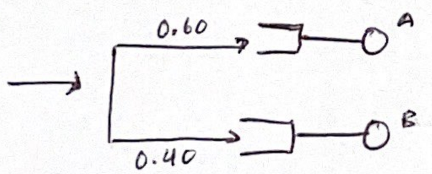
* $U = \lambda \cdot \bar{S} =$ $\lambda = 120$ $\bar{S} = 0.01$

* $U = 120 \cdot 0.01$

* $\boxed{U = 1.2}$

4) **UNBALANCED SERVICE LOADS**

GIVEN :



SERVER A → $U = 80\%$

SERVER B → $U = 60\%$, $\bar{S}_B = 250\ \mu s$

* SERVER B = $U_B = \bar{S}_B \cdot \lambda_B \longrightarrow \lambda_B = U_B / \bar{S}_B \longrightarrow \lambda_B = 0.60/250 = 0.024s$

$\lambda_k = V_k \cdot \lambda$ $V_k = 0.25$ → ARRIVAL RATE = 2.5 / MIN

* SERVER A = $U_A = \bar{S}_A \cdot \lambda_A \Rightarrow$ ~~[illegible]~~ $= \bar{S}_A = U_A/\lambda_A = \bar{S}_A =$

* SERVER B RECIEVES 40%, SERVER A RECIEVES 60%

∴ $0.60/0.40 = 1.5 \Rightarrow 1.5 \cdot \lambda_B = 0.036$

$U_A/\lambda_A = \bar{S}_A \Rightarrow 0.80/0.036 = 222$

$\boxed{\bar{S}_A = 222\ ms}$

THE M/M/1 QUEUE

- DEPARTURE TIME = EST[i] + ST[i] } DT
- RESIDENCE TIME = DT − AT

- EST → ENTER SERVICE TIME
- DT → DEPARTURE TIME
- AT → ARRIVAL TIME
- RT → RESIDENCE TIME

ARRIVAL TIME	SERVICE TIME	ENTER SERVICE TIME	DT	RT
1	3	1	4	3
3	2	4	6	3
5	4	6	10	5
7	1	10	11	4
8	1	11	12	4
13	2	13	15	2
14	1	15	16	2
17	3	17	20	3