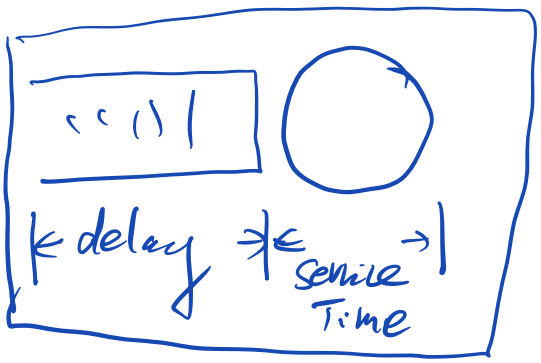
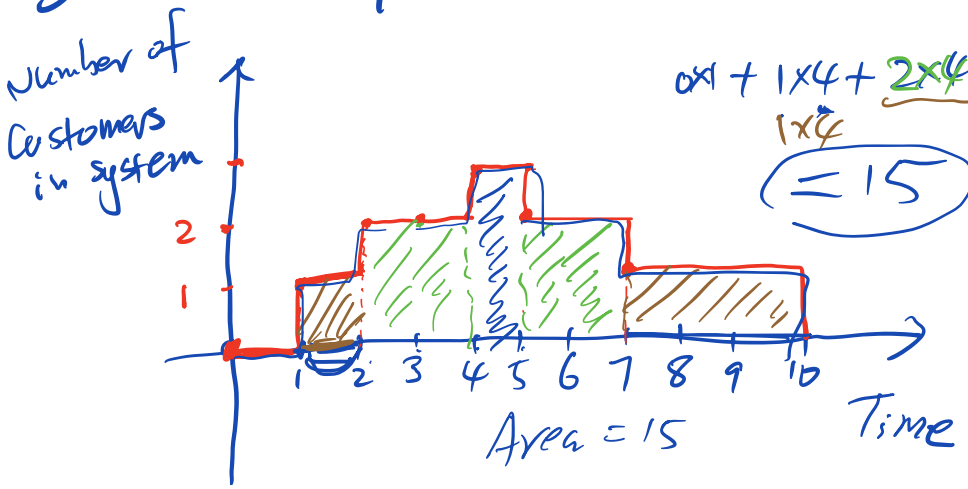
Single Server Queue Analysis (Little's Result)



Customer	Arrival Time	Departure Time	Time in System
1	1	5	4
2	2	7	5
3	4	10	6



Average number of customers in System:

N	Time	Probability
0	1	$\frac{1}{10} = 0.1$
1	4	$\frac{4}{10} = 0.4$
2	4	$\frac{4}{10} = 0.4$
3	1	$\frac{1}{10} = 0.1$

$$\bar{N} = 0 \times \frac{1}{10} + 1 \times \frac{4}{10} + 2 \times \frac{4}{10} + 3 \times \frac{1}{10}$$

$$= \frac{0 \times 1 + 1 \times 4 + 2 \times 4 + 3 \times 1}{10}$$

$$= \frac{15}{10} = \frac{\text{Area}}{10}$$

$$\bar{N} = \frac{\text{Area Under the Curve}}{10} = \frac{A}{10}$$

L Total Time

$$\bar{N} = \frac{A}{10} = \frac{A}{L}$$

Average Time in System

Time in System = Response Time = Waiting Time

$$\bar{T} = \frac{4+5+6}{3} = \frac{15}{3} = \frac{A}{3}$$

$$\bar{N} = \frac{A}{L} \qquad \bar{T} = \frac{A}{n}$$

n : total number of customers

$$A = \bar{N} L \quad = A = \bar{T} \cdot n$$

$$\boxed{\bar{N} L = \bar{T} n}$$

$$\bar{T} = \frac{\bar{N} \cdot L}{n} = \frac{\bar{N}}{\frac{n}{L}} ? = \frac{\bar{N}}{\lambda}$$

$n \rightarrow$ total number of customers

$L \rightarrow$ simulation length.

If $L = 100$ min

$n = 50$ customers

$\frac{100}{50}$

2 ——

Mean Interarrival Time

$= \frac{\text{Total Time}}{\text{Number of Customers}}$

$= \frac{L}{n}$

$\frac{50}{100}$

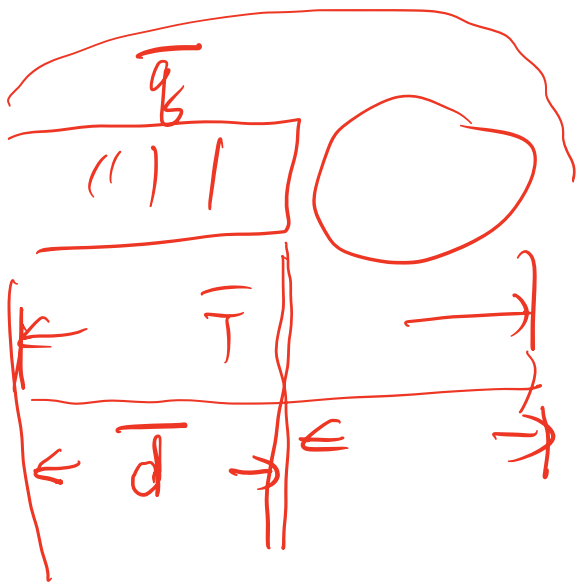
$\frac{\text{Number of Customers}}{\text{Time}}$

arrival rate

arrival rate : Average number of customers in one time unit.

denote by λ.

$$\bar{T} = \frac{\bar{N}}{\lambda} \qquad \bar{d} = \frac{\bar{q}}{\lambda}$$



$$\bar{s} = \frac{\bar{x}}{\lambda}$$

Mean number with server $\bar{x}$

Mean service time $\bar{s}$

$$\bar{T} = \frac{\bar{N}}{\lambda}$$

$$\bar{d} = \frac{\bar{q}}{\lambda}$$

$$\bar{s} = \frac{\bar{x}}{\lambda}$$

→ Little's Result

$\frac{1}{s} = \mu$

λ : Mean arrival rate

μ : mean service rate