* Notations n -> number of customers in the system Pn -> probability of n customers in the system 1 -> average customer arrival rate M → average service rate 1 = 9 = Average service completion time (1/4) Average interarrival time (1/A) -> traffic intensity / server utilization factor P. -> probability of no customer in the system s -> number of service channels N -> maximum number of customers allowed in the system La -> average no. of customers (in queue) Ls - average no. of customers (in queve + service) Wq -> average waiting time (in queue) No - average maiting time (in queue + service) Pw Probability that an arriving customer has to wait (system being busy), 1-P. = (x/11) For achieving a steady state cond, it is necessary that IIU < 1 N<

Francestial Service - Unimited Queue # Probability of being in system (waiting & being served) longer than time # to is given by P(Ns>t) = e-(N-X)t P(Ws = 1 - P(Ws 7 t) Probability of only waiting for service longer than time t is given by P (Wg > t) = 1 e - (M-X)t

#	Probability	that	the	system,	n	exceeds	a	given
	number, r					104 11		V
	nowider)	10	91461					

$$P(n > r) = \left(\frac{\lambda}{\lambda}\right)^{r+1}$$

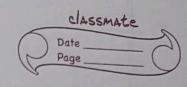
$$P_{0} = \left(\frac{\lambda}{\mu}\right)^{0} \left(1 - \frac{\lambda}{\lambda}\right) = g^{0}(1 - g)^{0} \cdot g < 1 \quad (\lambda < \mu)$$

Expected No. of customers in the system (queue + being served)

$$1s = f = \lambda$$
 $1-f = \lambda$
 $1-f = \lambda$

$$L_{q} = \lambda^{2}$$

$$\mu(\mu - \lambda)$$



The variance (fluctuation) length of queue $Var(n) = \Delta U$ $(U-\lambda)^2$

Probability that the queue is non empty

 $P(n>1) = 1 - P_0 - P_1$ (3) (3)

 $\frac{k}{k} \left(\frac{k-1}{k} - \frac{k-1}{k} \right) - \left(\frac{k}{k} - \frac{k}{k} \right)$

 $= \left(\frac{\lambda}{\mu}\right)^2$

 $P(n > r) = (\lambda)^{r+1}$

 $P(0 \ge r) = (\lambda)^{r}$

Expected length of non-empty queue:

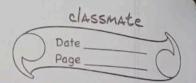
or we have the willished one

	TOOLS AND A TOOL OF THE PARTY O
Idle time = 8 hours - busy time = 8-5	Busy = 8 x 1 Time M
= 3	= 8× 5/4
₹ (1-3 = (= 2 N) 9
5 (8-	= 5 hours
3) =	->- 9 =

7 3 $\mathcal{M}(\mathcal{M}-\lambda')$ u(u-x') Increase = $\lambda^{-}\lambda$ = 0.06/min

M = 6 | hour M = 6 | hour $\text{Existing total hourly cost} = \text{wages + op \cdot ccst}$ $= (6 \times 3) + (\text{Ls} \times 20)$

	The state of the s
7	Model 2 : { (M/M/1): (N/FCFS) }
	Exponential service - Finite Overe
*	Performance measures for model 2
	P. = (1-9) 1 +1
	(1-9 ⁿ⁺¹) U
	Autor III
	1 1 1 = 1
	N+1 M
	The state of the s
	$P_{n} = \begin{cases} (1-\beta) P^{n}; n \leq N; \lambda \neq 1 \end{cases}$ $P_{n} = P_{n} \times P^{n}$
	1-9×+1 P = P. × 3
	19 9 7 9
	1 (27-15) = x=1 sin (svino sutral)7
	N+1 1 = 1 M Marker Siller
	AL CONTRACTOR OF THE PARTY OF T
1	Expected no. of customers in the system
1	dell motales amonto allala as I (a)
6.5	$\int_{ls} = \sum_{n=0}^{N} n P_n \tilde{\sigma} l = u^{2} b_{ns} \tilde{\sigma} = 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1$
483	The way and the geologist the way
	the sustain side shall sold instant of the sold in the same sate
	$\sqrt{l_s} = \left(\frac{g}{J} - (N+1) \frac{g^{N+1}}{J} + I(N+M) \right)$
	ls = 0 PN+1
	$f = 1 (\lambda = \mu)$
	A CONTRACTOR OF THE PROPERTY O
	2
	- Labers of customers waiting in greve
2.	Expected Numbers of customers waiting in greve
	(1- P.)
	V/q = [s - (1 1.7) = 1 - 1 = 1 - 1 = 1 - 1 = 1 = 1 = 1 = 1



3.	Expected	waiting	time	of	customer	in the
	system (waiting	+ sew	ice)	<u> 63 - 60</u>	Later Contract

M

4. Expected waiting time of a customer in the

5. Potential customer lost

Effective arrival rate, Act = 1(1-PN)

Effective traffic intensity, Best = De

M

Franched no. of electronics in the sustens