Queueing Formulas

Poisson Arrival Exponential Service (M/M/s)

	Description	One Server	Two Servers
P_0	Probability of no customers in system	$1-\frac{\lambda}{\mu}$	$\frac{2\mu-\lambda}{2\mu+\lambda}$
P_w	Probability of waiting for service	$\frac{\lambda}{\mu}$	$\frac{\lambda^2}{\mu(2\mu+\lambda)}$
L_q	Average number of customers in line	$\frac{\lambda^2}{\mu(\mu-\lambda)}$	$\frac{\lambda^3}{\mu(4\mu^2-\lambda^2)}$
L	Average number of customers in system	$\frac{\lambda}{\mu-\lambda}$	$\frac{4\mu\lambda}{4\mu^2-\lambda^2}$
W_q	Average time spent in line	$\frac{\lambda}{\mu(\mu-\lambda)}$	$\frac{\lambda^2}{\mu(4\mu^2-\lambda^2)}$
W	Average time spent in system	$\frac{1}{\mu-\lambda}$	$\frac{4\mu}{4\mu^2-\lambda^2}$

Poisson Arrival General Service (M/G/1)

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\begin{aligned}
P_0 &= 1-\frac{\lambda}{\mu} \\
P_w &= \frac{\lambda}{\mu} \\
L_q &= \frac{\lambda^2\sigma^2+\left(\frac{\lambda}{\mu}\right)^2}{2(1-\frac{\lambda}{\mu})} \\
L &= L_q + \frac{\lambda}{\mu} \\
W_q &= \frac{L_q}{\lambda} \\
W &= \frac{L}{\lambda}
\end{aligned}
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