Optimizing *s* in an M/M/s waiting system

$$\psi = \frac{\alpha}{s\mu} \qquad \{1\}$$

$$\mathrm{p0iQ} = \frac{(s\psi)^s}{s!(1-\psi)} \qquad \mathrm{p0iS} = \sum_{n=0}^{s-1} \frac{(s\psi)^n}{n!} \qquad \{2\}$$

$$p_0^{-1} = \mathrm{p0iQ} + \mathrm{p0iS} \qquad \{3\}$$

$$L_q = p_0 \frac{s^s \psi^{s+1}}{s!(1-\psi)^2} \qquad L = L_q + s\psi \qquad \{4\}$$

GLOBAL cost

From *s* and {4b},

$$E(\mathrm{ServerCost}) = C_s s \qquad E(\mathrm{SysWaitCost}) = C_w L \qquad \{5\}$$

$$\boxed{z_{GLOBAL} = E(\mathrm{ServerCost}) + E(\mathrm{SysWaitCost})} \qquad \{6\}$$

WAIT cost

$$s_{\mathrm{idle}} = s(1-\psi) \qquad \{7\}$$

From {7} and {4a},

$$E(\mathrm{IdleServerCost}) = C_s s_{\mathrm{idel}} \qquad E(\mathrm{WaitCost}) = C_w L_q \qquad \{8\}$$

$$\boxed{z_{\mathrm{WAIT}} = E(\mathrm{IdleServerCost}) + E(\mathrm{WaitCost})} \qquad \{9\}$$

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