Useful Formulae:

Operational Laws

Interactive Response time law:

$$R = \frac{N}{X} - Z$$

Asymptotic bounds on performance of interactive time-sharing system

$$\frac{N}{ND + Z} \leqslant X(N) \leqslant \min\left(\frac{1}{D_{max}}, \frac{N}{D+Z}\right)$$

$$\max\left(D, ND_{max} - Z\right) \leqslant R(N) \leqslant ND$$

M/M/1 queue

$$p_n = \rho^n(1-\rho), \; n = 0,1,2,...$$

$$L_Q = \frac{\rho}{1-\rho}$$

$$P(r \le t) = 1 - e^{-t/T_Q}$$

$$P(w \le t) = 1 - \rho e^{-t/T_{WD}}$$

M/M/1/K

$$p_n = \hat{\rho}^n p_0 \quad \text{for } n = 0,1,\cdots,K, \quad p_0 = \frac{1-\hat{\rho}}{1-\hat{\rho}^{K+1}}, \hat{\rho} \neq 1$$

$$L_Q = \frac{(K+1)\hat{\rho}^{K+1}}{\hat{\rho}^{K+1} - 1} + \frac{\hat{\rho}}{1-\hat{\rho}}, \quad \hat{\rho} \neq 1$$

M/G/1

$$T_w = \frac{\rho(1+cv_s^2)}{2(1-\rho)} \; T_s = \frac{\lambda E(s^2)}{2(1-\rho)}$$