

**Formulario:****Modelo M/M/1:**

$$p_n = (1 - \rho)(\rho)^n$$

$$\rho = \lambda / \mu$$

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

$$F_W(t) = 1 - e^{-(\mu - \lambda)t}$$

**Modelo M/M/c:**

$$p_n = \begin{cases} p_0 \frac{(\lambda/\mu)^n}{n!} & (n < c) \\ p_0 \frac{c^c}{c!} \left( \frac{\lambda}{c\mu} \right)^n & (n \geq c) \end{cases}$$

$$\rho = \frac{\lambda}{c\mu}$$

$$p_0 = \left[ \sum_{n=0}^{c-1} \frac{(\lambda/\mu)^n}{n!} + \frac{(\lambda/\mu)^c}{c!(1-\rho)} \right]^{-1}$$

$$P_q = \frac{P_c}{1 - \rho} = E_c(c, u)$$

$$L = \frac{P_q \rho}{1 - \rho} + c\rho$$

**Modelo M/M/c/c:**

$$p_n = p_0 \left( \frac{\lambda}{\mu} \right)^n \frac{1}{n!} \quad (0 \leq n \leq c)$$

$$p_0 = \left[ \sum_{n=0}^c \left( \frac{\lambda}{\mu} \right)^n \frac{1}{n!} \right]^{-1}$$

**Modelo M/G/1:**

$$L = \frac{\lambda^2 E[S^2]}{2(1 - \rho)} + \rho$$

$$\rho = \lambda / \mu$$

**Modelo M/M/1/K:**

$$p_n = p_0 \left( \frac{\lambda}{\mu} \right)^n \quad (0 \leq n \leq K)$$

$$p_0 = \begin{cases} \left[ \frac{1 - \lambda/\mu}{1 - (\lambda/\mu)^{K+1}} \right] & (\lambda \neq \mu) \\ \frac{1}{K+1} & (\lambda = \mu) \end{cases}$$

$$\rho = \begin{cases} \frac{\lambda}{\mu} \left[ \frac{1 - (\lambda/\mu)^K}{1 - (\lambda/\mu)^{K+1}} \right] & (\lambda \neq \mu) \\ \frac{K}{K+1} & (\lambda = \mu) \end{cases}$$

$$L = \begin{cases} \frac{\lambda/\mu}{1 - \lambda/\mu} \left[ \frac{1 - (K+1)(\lambda/\mu)^K + K(\lambda/\mu)^{K+1}}{1 - (\lambda/\mu)^{K+1}} \right] & (\lambda \neq \mu) \\ \frac{K}{2} & (\lambda = \mu) \end{cases}$$

**Modelo M/M/1/M**

$$p_n = p_0 \binom{M}{n} n! \left( \frac{\lambda}{\mu} \right)^n = p_0 \frac{M!}{(M-n)!} \left( \frac{\lambda}{\mu} \right)^n$$

$$p_0 = \left[ \sum_{n=0}^M \frac{M!}{(M-n)!} \left( \frac{\lambda}{\mu} \right)^n \right]^{-1}$$

$$\rho = 1 - p_0$$

$$L = M - \frac{\lambda'}{\lambda} = M - \frac{\mu}{\lambda} \rho$$

**Modelo M/M/c/M**

$$p_n = \begin{cases} p_0 \binom{M}{n} \left( \frac{\lambda}{\mu} \right)^n & (0 \leq n < c) \\ p_0 \binom{M}{n} \frac{n!}{c^{n-c} c!} \left( \frac{\lambda}{\mu} \right)^n & (c \leq n < M) \end{cases}$$

$$p_0 = \left[ \sum_{n=0}^{c-1} \binom{M}{n} \left( \frac{\lambda}{\mu} \right)^n + \sum_{n=c}^M \binom{M}{n} \frac{n!}{c^{n-c} c!} \left( \frac{\lambda}{\mu} \right)^n \right]^{-1}$$

$$\rho = 1 - \sum_{n=0}^{c-1} p_n \frac{c-n}{c}$$

$$L = M - \frac{\lambda'}{\lambda} = M - \frac{c\mu}{\lambda} \rho$$