M/M/1

Average Number in System =

$$E[K] = \frac{\rho}{1-\rho}$$

Variance of *Number in System* =

$$\mathrm{Var}[K] = \frac{\rho}{(1-\rho)^2}$$

Delay through System =

$$E[D] = \frac{1}{\mu(1-\rho)} = \frac{\frac{E[L]}{R_{out}}}{(1-\rho)} = \frac{E[Holding\ time]}{(1-\rho)} = \frac{1}{\mu-\lambda}$$

Probability of k in system=P[K=k] = $\rho^k(1-\rho)$
Probability of system busy = utilization= ρ
Probability of system empty = 1-ρ

M/M/1/S

$$P[K=k] = \frac{(1-\rho)\rho^k}{1-\rho^{S+1}} \text{ for } k \le S$$

$$P[K=k] = 0 \text{ for } k > S$$

$$P_{Blocking} = P[K=S] = \frac{(1-\rho)\rho^S}{1-\rho^{S+1}}$$

Table to be provided on test and Excel spreadsheet provided on class web site see http://www.ittc.ku.edu/~frost/EECS_563/M-M-1-K-Blocking%20cal.xls

M/M/S/S

$$P[K=k] = \frac{\frac{\rho^k}{k!}}{\sum_{n=0}^{S}\frac{\rho^n}{n!}}$$

$$P[K=k] = 0 \text{ for } k > S$$

$$P_{Blocking} = P[K=S] = \frac{\frac{\rho^S}{S!}}{\sum_{n=0}^{S}\frac{\rho^n}{n!}}$$

Erlang B blocking Formula
Tabulated and there are web calculators see:
http://www.erlang.com/calculator/index.htm
http://www.ittc.ku.edu/~frost/EECS_563/LOCAL/erlang-table.pdf