**M/M/1**

Average Number in System =

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

Variance of Number in System =

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

Delay through System =

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

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

Probability of system busy = utilization = $\rho$

Probability of system empty = $1-\rho$

**M/M/1/S**

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

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

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

Table to be provided on test and Excel spreadsheet provided on class web site


**M/M/S/S**

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

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

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

**Erlang B blocking Formula**

Tabulated and there are web calculators see:
