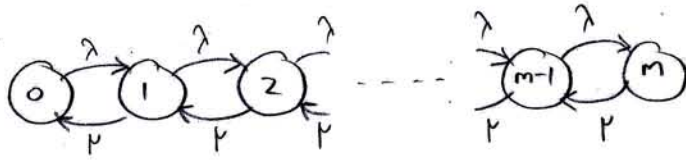


3.21 M/M/1/m queue (no more than m customers in the system)



Global balance equations give :

$$P_{n+1} = \rho P_n, \quad n = 0, 1, 2, \dots, m-1 \quad (\text{where } \rho = \frac{\lambda}{\mu})$$

$$\text{Then } \boxed{P_n = \rho^n P_0, \quad n = 0, 1, 2, \dots, m}$$

$$\text{To find } P_0 : \sum_{n=0}^m P_n = 1$$

$$\Rightarrow P_0 \left(\sum_{n=0}^m \rho^n \right) = 1$$

$$\Rightarrow P_0 \left(\frac{1 - \rho^{m+1}}{1 - \rho} \right) = 1$$

$$\Rightarrow \boxed{P_0 = \frac{1 - \rho}{1 - \rho^{m+1}}}$$

Therefore,

$$\boxed{P_n = \rho^n \left(\frac{1 - \rho}{1 - \rho^{m+1}} \right) \text{ for } n = 0, 1, \dots, m}$$