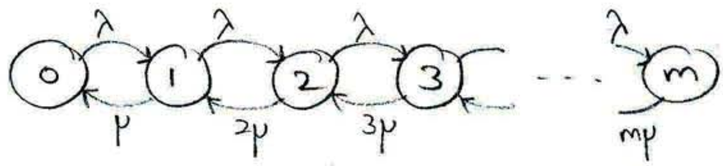
3.26

The system can be described by a continuous time M.C.
Define the state of the M.C. to be the number of operational machines

Time to fix a machine $\sim$ exponential (mean $= \frac{1}{\lambda}$)
Time to failure (of any machine) $\sim$ exponential (mean $= \frac{1}{\mu}$)
Machines fail independent of each other.



(similar to an M/M/m/m queue)

$$P_n = P_0 \, \frac{\lambda}{n\mu} \cdot \frac{\lambda}{(n-1)\mu} \cdot \cdots \frac{\lambda}{2\mu} \cdot \frac{\lambda}{\mu} = P_0 \frac{\lambda^n}{n! \, \mu^n} \qquad n = 0, 1, \ldots, m$$

$$\sum_{n=0}^{m} P_n = 1 \quad \Rightarrow \quad P_0 \sum_{n=0}^{m} \frac{(\lambda/\mu)^n}{n!} = 1$$

$$\mathbb{P}(\text{no operational machine}) = P_0 = \frac{1}{\sum_{n=0}^{m} \frac{(\lambda/\mu)^n}{n!}}$$

The steady-state portion of time where there is no operational machine $= \mathbb{P}$(no operational machine)