YÖNEYLEM ARAŞTIRMASI-III

1) $\boldsymbol{X}$, $\boldsymbol{\lambda}$ parametresi ile üstel dağılıma uygun bir rassal değişken ise,

a) $P(X=t)=f(t)=\lambda e^{-\lambda t}$

b) $P(X>t)=1-F(t)=e^{-\lambda t}$

c) $E[X]=\frac{1}{\lambda}$

2) Üstel dağılımın unutkanlık özelliği vardır. Buna göre, $P(X>t+s|X>t)=P(X>s)$,

3) T, $\boldsymbol{\lambda}$ parametresi ile poisson dağılıma uygun bir rassal değişken ise, t *döneminde* n *olay olma olasılığı* $p_n(t)=\frac{(\lambda t)^n e^{-\lambda t}}{n!}$

4) Kuyruk uzunluğu N ve hizmet sıklığı μ olan, saf ölüm modeline uygun bir kuyruk sisteminde, t anında, n müşteri kalma olasılığı, $p_n(t)=\frac{(\mu t)^{N-n}e^{-\mu t}}{(N-n)!}$ dir.

5) Genelleştirilmiş Poisson Kuyruk Modelinde;

a) Sistemde n müşteri olma olasılığı;

$$p_n=\left(\frac{\lambda_{n-1}\lambda_{n-2}\cdots\lambda_1\lambda_0}{\mu_n\mu_{n-1}\cdots\mu_2\mu_1}\right)p_0$$

b) Sistemde hiç müşteri olmama olasılığı;

$$p_0=1-\sum_{n=1}^{\infty}p_n$$

6) Kararlılık durumu performans ölçütleri;

a) $L_s=\sum_{n=1}^{\infty}np_n=\lambda_{eff}W_s$

b) $L_q=\sum_{n=(c+1)}^{\infty}(n-c)p_n=\lambda_{eff}W_q$

c) $W_s=W_q+\frac{1}{\mu}$

d) $L_s=L_q+\frac{\lambda_{eff}}{\mu}$

e) $\overline{c}=L_s-L_q=\frac{\lambda_{eff}}{\mu}$

f) $\rho=\frac{\lambda}{\mu}$

g) $\lambda=\lambda_{eff}+\lambda_{lost}$

7) (M/M/1):(GD/∞/∞) ;

a) $p_n=\left(\frac{\lambda}{\mu}\right)^n p_0=\rho^n p_0$

b) $p_0=1-\rho$

c) $L_s=\frac{\rho}{1-\rho}$

d) $W_s=\frac{L_s}{\lambda}=\frac{1}{\mu(1-\rho)}$

e) $W_q=W_s-\frac{1}{\mu}=\frac{\rho}{\mu(1-\rho)}$

f) $L_q=\lambda W_q=\frac{\rho^2}{(1-\rho)}$

g) $\overline{c}=L_s-L_q=\rho$

8) (M/M/1):(GD/N/∞) ;

a) $p_n=\begin{cases}\rho^n p_0 & n\le N\\ 0 & n>N\end{cases}$

b) $p_0=\begin{cases}\frac{(1-\rho)\rho^n}{1-\rho^{N+1}} & \rho\ne 1\\ \frac{1}{N+1} & \rho=1\end{cases}$

c) $\lambda_{lost}=\lambda p_N$

d) $\lambda_{eff}=\lambda(1-p_{N)}$

e) $L_s=\begin{cases}\sum_{n=0}^{N}np_n=\frac{\rho\{1-(N+1)\rho^n+N\rho^{n+1}\}}{(1-\rho)(1-\rho^{n+1})} & \rho\ne 1\\ \frac{N}{2} & \rho\ne 1\end{cases}$

f) $W_s=\frac{L_s}{\lambda_{eff}}$

g) $W_q=W_s-\frac{1}{\mu}$

h) $L_q=\lambda_{eff}W_q$

i) $\overline{c}=L_s-L_q=\rho$

9) (M/M/c):(GD/∞/∞) ;

a) $p_n=\begin{cases}\frac{\lambda^n}{n!\mu^n}p_0 & n\le c\\ \frac{\lambda^n}{c!c^{n-c}\mu^n}p_0 & n>c\end{cases}$

b) $p_0=\left\{\sum_{n=0}^{c-1}\frac{\rho^n}{n!}+\frac{\rho^c}{c!}\left(\frac{1}{1-\frac{\rho}{c}}\right)\right\}^{-1}$ $\quad \frac{\rho}{c}<1$

c) $L_q=\sum_{n=c}^{\infty}(n-c)p_n=\frac{\rho^{c+1}}{(c-1)!(c-\rho)^2}p_0$

d) $L_s=L_q+\rho$

e) $\lambda_{eff}=\lambda,\quad W_s=\frac{L_s}{\lambda},\quad W_q=\frac{L_q}{\lambda}$

10) (M/M/c):(GD/N/∞) ; c≤N

a) $p_n=\begin{cases}\frac{\rho^n}{n!}p_0 & 0\le n\le c\\ \frac{\rho^n}{c!c^{n-c}}p_0 & c\le n\le N\end{cases}$

b) $p_0=\begin{cases}\left[\sum_{n=0}^{c-1}\frac{\rho^n}{n!}+\frac{\rho^c\left(1-\left(\frac{\rho}{c}\right)^{N-c+1}\right)}{c!\left(1-\frac{\rho}{c}\right)}\right]^{-1} & \frac{\rho}{c}\ne 1\\ \left[\sum_{n=0}^{c-1}\frac{\rho^n}{n!}+\frac{\rho^c}{c!}(N-c+1)\right]^{-1} & \frac{\rho}{c}=1\end{cases}$

c) $L_q=\frac{\rho^{c+1}}{(c-1)!(c-\rho)^2}\left\{1-\left(\frac{\rho}{c}\right)^{N-c+1}-(N-c+1)\left(1-\frac{\rho}{c}\right)\left(\frac{\rho}{c}\right)^{N-c}\right\}p_0$

d) $\frac{\rho}{c}=1$ için $L_q=\frac{\rho^c(N-c)(N-c+1)}{2c!}p_0$

e) $\lambda_{lost}=\lambda p_N$

f) $\lambda_{eff}=\lambda-\lambda_{lost},\quad W_s=\frac{L_s}{\lambda_{eff}},\quad W_q=\frac{L_q}{\lambda_{eff}}$

11) (M/M/∞):(GD/∞/∞) – Self Servis Modeli

a) $p_n=\frac{e^{-\rho}\rho^n}{n!}\quad n=0,1,2,\ldots$

b) $L_s=\rho,\quad L_q=W_q=0$