Chapter 8
Queueing Networks

8.1. (a) 0.0625.
(b) 15.
(c) 1 hr
(d) 0.16
(e) E[number passes] = 1.25

8.3. Note that in the diagram, the $\gamma_1 = 0.2 \times 24$, $\gamma_2 = 0.6 \times 24$, and $\gamma_3 = 0.2 \times 24$.

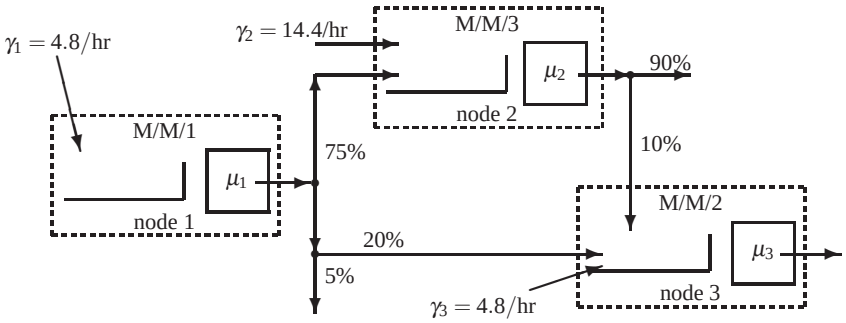

Fig. 8.1 Representation of the queueing network for Exercise 5.17 (a).

(a)
(b)

$$\mathbf{P} = \begin{bmatrix} 0 & 0.75 & 0.2 \\ 0 & 0 & 0.1 \\ 0 & 0 & 0 \end{bmatrix}$$

(c) $W_q = 1.77$ min
(d) $L = L_1 + L_2 + L_3 = 6.528$
(e) $W_{system} = 16.32$ min

(f) $E[\text{minutes per hour at least one counselor free}] = 20.94$ min.
(g) The new switching probability matrix is

$$\mathbf{P} = \begin{bmatrix} 0 & 0.75 & 0.2 \\ 0 & 0 & 0.1 \\ 0 & 0.15 & 0 \end{bmatrix} .$$

$\lambda_1 = 4.8$, $\lambda_2 = 19.151$, $\lambda_3 = 7.675$
$L_q = 0.712$
$W_q == 2.23$min
$L = L_1 + L_2 + L_3 = 7.03$

8.5. Mean service times: 0.25, 1.3333, 1.8567, and 1.0667.
Arrival rates after 5 interations: 0.552, 0.572, 0.400, and 0.552.
Conclusion: System output = 0.552/hr. Old system had an output rate of 0.507/hr; thus, the preparation room is worthwhile since it increases output.