Indian Institute of Technology Bombay

Department of Electrical Engineering

Handout 15 EE 706 Communication Networks

Quiz 6 : **10 points** March 4, 2010

Please READ THE QUESTIONS CAREFULLY before answering.

1. $\{A(t)|t \geq 0\}$ is a *Poisson process* with rate λ. So the number of arrivals in any interval of length τ is Poisson distributed with parameter $\lambda\tau$,

$$\Pr\{A(t+\tau) - A(t) = n\} = e^{-\lambda\tau}\frac{(\lambda\tau)^n}{n!}, \quad n = 0, 1, 2, \ldots$$

   (a) If $\lambda = 1$ arrival per second, what is the the probability of zero arrivals from time $t = 5$s to $t = 10$s? [1 point]

   (b) If $\lambda = 1$ arrival per second, what is the the probability of zero arrivals from time $t = 5$s to $t = 10$s given that there was one arrival in the interval of time $[0, 5)$? [1 point]

2. The interarrival times of a Poisson process are independent and exponentially distributed. So if τ_n is the time between the arrivals of the nth and $(n-1)$th customers, we have

$$\Pr[\tau_n \leq s] = 1 - e^{-\lambda s}, \text{ for } s \geq 0.$$

   (a) If $\lambda = 1$ arrival per second, what is the the probability that the fourth customer will arrive at least 5 seconds after the third customer arrived? [1 point]

   (b) If $\lambda = 1$ arrival per second, what is the the probability that the fourth customer will arrive at least 5 seconds after the third customer and the fifth customer will arrive at most 10 seconds after the fourth customer? [1 point]

3. Suppose a queueing system has no customers in it at time $t = 0$. If customer arrivals occur at times $t = 1, 3, 4$ and customer departures occur at times $t = 2, 5, 6$, plot $\alpha(t)$ = The number of arrivals in the system upto time t, $\beta(t)$ = The number of departures in the system upto time t and $N(t)$ = The number of customers in the system at time t. [6 points]