

## Review Problems for Exam 1

**Problem 1.** Passengers arrive at the Bellman Airlines check-in counter from 6:00 to 22:00 according to a stationary Poisson process at a rate of 40 per hour. 15% of the passengers arriving at the check-in counter are traveling in first class.

- a. Suppose it is 12:00. What is the probability that the next passenger arrives within 2 minutes (1/30 hour)?
- b. What is the probability that the 300th passenger arrives at or before 12:00, given that exactly 150 passengers arrive between 6:00 and 8:00?
- c. What is the expected number of arrivals by the end of the day (6:00 - 22:00), given that exactly 250 passengers arrived between 6:00 and 12:00?
- d. What is the expected arrival time of the 60th first class passenger?
- e. What is the probability that 5 or more first class passengers arrive in the first hour and the last hour that the check-in counter is open?

**Problem 2.** Traffic engineers believe that the number of accidents at the intersection of College Avenue and King George Street follows a nonstationary Poisson process.

- a. Using some preliminary data, they determined that the arrival rate function is:

$$\lambda(\tau) = \begin{cases} 10 & \text{if } 0 \leq \tau < 6 \\ 4 & \text{if } 6 \leq \tau \leq 12 \end{cases}$$

where the time  $\tau$  is in months, and  $\tau = 0$  corresponds to the beginning of January. What is the integrated rate function  $\Lambda(\tau)$ ?

- b. After collecting some more data, the traffic engineers have actually determined that the integrated rate function should be

$$\Lambda(\tau) = \begin{cases} 10\tau & \text{if } 0 \leq \tau < 3 \\ 6\tau + 2 & \text{if } 3 \leq \tau < 9 \\ 8\tau - 6 & \text{if } 9 \leq \tau \leq 12 \end{cases}$$

What is the expected number of accidents from the beginning of March to the end of May?

- c. What is the probability that there are at most 15 accidents from the beginning of March to the end of May, if there are exactly 30 accidents from the beginning of January to the end of February?

**Problem 3.** You have been hired as a consultant for Markov Mobile Networks, a company that provides cellular phone service. Their engineers believe that phone calls arrive at a cell tower according to a stationary Poisson process. Describe what assumptions need to be made about phone call arrivals in order for this to be true. (You do not need to assess whether these assumptions are realistic.)