

Probability and Queueing Theory

Important 13Mark Questions

Unit I

1. The probability mass function of a discrete R. V X is given in the following table:

X	-2	-1	0	1	2	3
$P(X=x)$	0.1	K	0.2	$2k$	0.3	k

Find (1) the value of k (2) $P(X < 1)$ (3) $P(-1 < X \leq 2)$ (4) $E(X)$.

2. The annual rainfall in inches in a certain region has a normal distribution with a mean of 40 and variance of 16. What is the probability that the rainfall in a given year is between 30 and 48 inches?

Unit II

1. Find the constant k such that
$$f(x, y) = \begin{cases} k(x+1)e^{-y}, & 0 < x < 1, y > 0 \\ 0, & \text{otherwise} \end{cases}$$

Is a joint p. d. f. of the continuous R. V. (X, Y) . Are X and Y independent R. Vs? Explain.
2. If X and Y each follow an exponential distribution with parameter 1 and are independent, find the probability density function of $U = X - Y$.

Unit III

1. Consider a random process $Y(t) = X(t) \cos(w_0 t + \theta)$, where $X(t)$ is wide sense stationary process, θ is a uniformly distributed R. V. over $(-\pi, \pi)$ and w_0 is a constant. It is assumed that $X(t)$ and θ are independent. Show that $Y(t)$ is a wide-sense stationary.
2. On the average a submarine on patrol sights 6 enemy ships per hour. Assuming that the number of ships sighted in a given length of time is a Poisson variate. Find the probability of sighting 6 ships in the next half-an-hour, 4 ships in the next 2 hours and at least 1 ship in the next 15 minutes.

Unit IV

1. A petrol pump station has 4 petrol pumps. The service time follows an exponential distribution with mean of 6 minutes and cars arrive for service in a Poisson process at the rate of 30 cars per hour.
- (1) Find the probability that no car is in the system.
(2) What is the probability that an arrival will have to wait in the queue?
(3) Find the mean waiting time in the system.
2. There are three typists in an office. Each typist can type an average of 6 letters per hour. If letters arrive for being typed at the rate of 15 letters per hour:
- (i) What fraction of time all the typist will busy?
(ii) What is the average number of letters waiting to be typed?
(iii) What is the average time a letter has to spend for waiting and for being typed?
(iv) What is the probability that a letter will take longer than 20 minutes waiting to be typed and being typed?

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Unit V

1. Consider a queueing system where arrivals are according to a Poisson distribution with mean 5 per hour. Find the expected waiting time in the system. If the service time distribution is (i) Uniform between: $t = 5$ minutes and $t = 15$ minutes (ii) Normal with mean 3 minutes and standard deviation 2 minutes.
2. Derive Pollaczek-Khinchine formula for M/G/1 queueing system.

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