Roll No:
(To be filled in by the candidate)

PSGCOLLEGE OF TECHNOLOGY, COIMBATORE - 641 004
SEMESTER EXAMINATIONS, SEPTEMBER / OCTOBER 2018
MSc - SOFTWARE SYSTEMS Semester: 2
15XW21 PROBABILITY AND STATISTICS

Duration : 3 Hours   **Maximum Marks : 100**

INSTRUCTIONS:

1. Answer **ALL** questions. Each question carries 20 Marks.
2. Subdivision (a) carries 3 marks each, subdivision (b) carries 7 marks each and subdivision   (c) carries 10 marks each.
3. Statistical table brought by the candidates shall be permitted.

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1. a) Suppose that the events A and B are disjoint and that each has positive probability. Are A and B independent?

   b) i) Comment on the following argument: A fair coin is tosses three times and the number of tails is obtained observes. Since the number of heads obtained can be 0, 1, 2, or 3, the probability of obtaining no tails is 1/4.   [3]

      ii) Suppose that each of two dice is biased so that when either die is rolled, the probability that the number k will appear is 0.1 for $k = 1, 2, 5,$ or 6 and is 0.3 for $k = 3$ or 4. If these two dice are rolled independently, what is the probability that the sum of the two numbers that appear will be 7?   [4]

   c) i) Alice and Bob go target shooting together. Both shoot at a target at the same time. Suppose Alice hits the target with probability 0.7, whereas Bob, independently, hits the target with probability 0.4. (1) Given that exactly one shot hit the target, what is the probability that it was Bob's shot? (2) Given that the target is hit, what is the probability that Bob hit it?   [5]

      ii) A cancer diagnostic test is 95% accurate both on those who have cancer and on those who do not. If 0.005 of the population actually does have cancer, find the probability that a particular individual has cancer, given that the test indicates he or she has cancer.   [5]

2. a) Suppose that X is a discrete random variable with $E(X) = 1$ and $E[X(X - 2)] = 3$. Find the variance of $(-3X + 5)$.

   b) i) The diameter X (in cm) of an electric cable is a continuous random variable with pdf $f(x) = 6x(1 - x), 0 \leq x \leq 1$. For what value of k, $P[X < k] = P[X > k]$?   [3]

      ii) From an urn that contains five red, five white, and five blue chips, we draw two chips at random. For each blue chip we win \$1, for each white chip we win \$2, but for each red chip we lose \$3. If X represents the amount that we either win or we lose, what is the expected value of X?   [4]

   c) The daily sales of rice X (in hundreds of kilograms) in a grocery store is a random variable whose distribution function is given by $F(x) =$

   $$\begin{cases} 0 , & x < 0 \\ kx^2, & 0 \leq x < 3 \\ k(-x^2 + 12x - 3), & 3 \leq x < 6 \\ 1, & x \geq 6 \end{cases}.$$

   Suppose that this store's total sales of rice do not reach 600 kg on any given day.

      (i)   Find the value of k.
      (ii) What is the probability that it sells between 200 and 400 kg rice on next Thursday?
      (iii) What is the probability that it sells over 300 kg rice on next Thursday?
      (iv) Given that the store sold at least 300 kg of rice last Friday, what is the probability that it did not sell more than 400 kg on that day?

3. a) The probability of error in the transmission of a bit over a communication channel is 10^{-4}. What is the probability of more than three errors in transmitting a block of 1000 bits?

b) i) From the interval (0, 1), five points are selected at random and independently. What is the probability that at least two of them are less than 1/3? [3]

ii) Obtain the moment generating function of exponential distribution. Hence find its mean and variance. [4]

c) (i) The demand for meat at a meat store during any week is approximately normally distributed with a mean of 5000 kg and a standard deviation of 300 kg.
(1) If the store has 5300 kg of meat, what is the probability that it is overstocked?
(2) How much meat should be in stock per week so as not to run short more than 10% of the time? [5]

(ii) The joint probability density function of random variables X and Y is given by $f(x,y) = \begin{cases} c\,xy^2, & 0 \le x \le y \le 1 \\ 0 & otherwise \end{cases}$. Find the value of c and the marginal density functions of X and Y. [5]

4. a) Suppose the null hypothesis states: Vitamin C is effective in controlling colds. What action will constitute a Type I error? What action will constitute Type II error?

b) i) What are the characteristics of a good estimator? [3]

ii) The average amount spent in a sample of 49 customers for dinner at a major multi-cuisine restaurant gave a mean of Rs.480. Assume a population standard deviation of Rs.100. Find a 95% confidence interval for population mean. [4]

c) i) The mean life time of a sample of 400 florescent light bulbs produced by a company is found to be 1600 hours with a standard deviation of 150 hours. At 1% level of significance, test the hypothesis that the mean life time of the bulbs produced in general is higher than 1570 hours. [5]

ii) In order to find whether 'efficiency in job' depends on the 'academic performance', 400 persons were examined yielding the data in Table.1. At 5% LOS, test the claim that 'efficiency in job' is independent of 'academic performance'. [5]

Academic performance

		Excellent	Good	Average
	Excellent	23	60	29
Efficiency Table.1 in job	Good	28	79	60
	Average	9	49	63

5. a) Can $2x + 3y = 4$ and $x - y = 5$ be equations of valid regression lines? Why or why not?

b) i) In design of experiments, what is Randomized Block Design? [3]

ii) X and Y are two independent variables such that $\overline{X} = 5, \overline{Y} = 10, \sigma_x = 4$, and $\sigma_y = 9$ If $U = 3X + Y$ and $V = 3X - Y$, what is the correlation coefficient between U and V? [4]

c) i) Three training methods were compared to see whether they led to greater productivity after training. The productivity measures for individuals trained by each method are as in Table.2. Using ANOVA, determine at 5% LOS whether three training methods lead to different levels of productivity.

Table.2	Method 1	45	40	50	39	53	44
	Method 2	59	43	47	51	39	49
	Method 3	41	37	43	40	52	37

[OR]

ii) From the data in Table.3, obtain the regression line of Y on X and the regression line of X on Y. Also find the coefficient of correlation between X and Y.

Table.3	X	25	28	35	32	31	36	29	38	34	32
	Y	43	46	49	41	36	32	31	30	33	39

FDRL

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