

Code No: R21052

R10
SET - 1
II B. Tech I Semester Supplementary Examinations, June - 2015
PROBABILITY AND STATISTICS

(Com. to CSE, IT)

Time: 3 hours

Max. Marks: 75

 Answer any **FIVE** Questions
 All Questions carry **Equal** Marks

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1. a) Among 100 students 50 are studying Maths, 30 are studying Physics, and 20 are studying Maths and Physics. If a student is chosen at random find the probability that the student is (i) studying Maths or Physics (ii) studying neither Physics nor Maths.  
 b) Companies  $B_1$ ,  $B_2$  and  $B_3$  produce 30%, 45% and 25% of the cars respectively. It is known that 2%, 3% and 2% of these cars produced are defective. (i) What is the probability that a car purchased is defective. (ii) If a car purchased is found to be defective, what is the probability that this car is produced by the company
2. a) If  $X$  is a continuous random variable with p.d.f  $f(x) = x^2$ ,  $0 \leq x \leq 1$ ,  $= 0$ , elsewhere.  
 If  $p(a \leq x \leq 1) = \frac{19}{81}$ , find the value of 'a'.  
 b) A random variable  $X$  has the following probability function
 

|        |   |     |      |      |      |       |        |            |
|--------|---|-----|------|------|------|-------|--------|------------|
| $x$    | 0 | 1   | 2    | 3    | 4    | 5     | 6      | 7          |
| $p(x)$ | 0 | $k$ | $2k$ | $2k$ | $3k$ | $k^2$ | $2k^2$ | $7k^2 + k$ |

 Determine (i)  $k$ , (ii)  $P(0 \leq x \leq 4)$ , (iii) the minimum value of 'x' such that  $P(X \leq x) > \frac{1}{2}$
3. a) A hospital switch board receives an average of 4 emergency calls in a 10 minute interval. What is the probability that (i) there are at most 2 emergency calls in a 10 minute interval, (ii) there are exactly 3 emergency calls in a 10 minute interval.  
 b) If  $X$  is normally distributed with mean 2 and variance 0.1, then find  $P(|X-2| \geq 0.01)$  ?
4. a) The average marks scored by 32 boys is 72 with a S.D. of 8. While that for 36 girls is 70 with a S.D. of 6. Does this indicate that the boys perform better than girls at level of significance 0.05?  
 b) An electrical firm manufactures light bulbs that have a length of life is approximately normal distribution with a standard deviation of 100 hours, prior experience leads us to believe that  $\mu$  is a value of normal random variable what mean  $\mu_0 = 800$  hours and standard deviation  $\sigma_0 = 10$  hrs. If a random sample of 25 bulbs has an average life of 780 hours. Find 95% Bayesian interval for  $\mu$ .

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5. A random sample from a company's very extensive files show that orders for a certain piece of machinery were filled, respectively in 10,12,19,14,15,18,11 and 13 days. Use the level of significance  $\alpha = 0.01$  to test the claim that on the average such orders are filled in 10.5 days. Choose the alternative hypothesis so that rejection of the null hypothesis  $\mu = 10.5$  days implies that it takes longer than indicated.

6. Fit a Poisson distribution to the following data and for its goodness of fit at level of significance 0.05?

|     |     |     |     |    |    |
|-----|-----|-----|-----|----|----|
| $x$ | 0   | 1   | 2   | 3  | 4  |
| $f$ | 419 | 352 | 154 | 56 | 19 |

7. Twenty-five successive samples of 200 switches, each taken from a production line, contained, respectively 6,7,13,7,0,9,4,6,0,4,5,11,6,18,1,4,9,8,2,17,9,12,10,5 and 4 defectives. If the fraction of defectives is to be maintained at 0.02, construct a  $p$  chart for these data and state whether or not this standard is being met.
8. A telephone booth with Poisson arrivals spaced 10 minutes apart on the average, and exponential call lengths averaging 3 minutes. What is the probability that an arrival will have to wait more than 10 minutes before the phone is free? What is the probability that it will take him more than 10 minutes altogether to wait for phone and complete his call? Estimate the fraction of a day that the phone will be in use. Find the average number of units in the system.

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1. a) If $P(A^c) = 3/8$, $P(B^c) = 1/2$ and $P(A \cap B) = 1/4$, find

$P(A|B)$ and $P(B|A)$ and $P(A|B^c)$.

- b) What is the probability that a leap year selected at random will contain 53 Sundays?

2. a) If a random variable has the probability density function

$$f(x) = k(x^2 - 1), -1 \leq x \leq 3,$$

$$= 0, \text{ else where}$$

Find the value of 'k' and $p(\frac{1}{2} \leq x \leq \frac{5}{2})$.

- b) Let X denote the sum of the two numbers that appear when a pair of fair dice is tossed.

Determine the (i) Distribution function, (ii) mean and (iii) variance.

3. a) Fit a Poisson distribution to the following data

x	0	1	2	3	4	5	6	7
f	305	365	210	80	28	9	2	1

- b) In a normal population with mean 15 and SD 3.5, it is found that 647 observations exceed 16.25. What is the total number of observations in the population?

- 4 a) In a test given to two groups of students, marks obtained are as follows

Group I:	18	20	36	50	49	36	34	49	41
Group II:	29	28	26	35	30	44	44		

Examine the significance of the difference between the means of the marks secured by students of the above groups?

- b) Determine 99% confidence interval for the mean of contents of soft drink bottles if contents of 7 such soft drink bottles are 10.0, 10.4, 9.8, 10, 9.8, 10.2, 9.6 ml.

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5. a) A sample of cam shafts intended for use in gasoline engines has an average eccentricity of 1.02 and a standard deviation of 0.044 inch. Assuming the data may be treated a random sample from a normal population, determine a 95% confidence interval for the actual mean eccentricity of a cam shaft?
- b) 20 people were attacked by a disease and only 18 survived will you reject the hypothesis that the survival rate if attacked by this disease is 85% in favour of the hypothesis that is more at 5% level.

6. Two random samples are drawn from two normal populations as follows:

A	17	27	18	25	27	29	13	17
B	16	16	20	27	26	25	21	

Test whether the samples are drawn from the same normal population. Use a 0.05 level of significance.

7. Explain, from the perspective of quality improvement programs, why the $\bar{x}$, R , and *fraction defective* charts should be used to listen to the process and observe its natural variability at any stage, rather than for the long-run control of the process.
8. In a railway marshalling yard, goods trains arrive at a rate of 30 trains per day. Assuming that the inter-arrival time follows an exponential distribution and the service time (the time taken to hump a train) distribution is also exponential with an average 36 minutes. Calculate the following.
- (i) The average number of trains in the queues.
- (ii) The probability that the queue size exceeds 10.
- If the input of trains increases to an average 33 per day, what will be change in (i) and (ii)?

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1. a) An integer is chosen at random from the first 100 positive integers . What is the probability that the integer chosen is divisible by 2 or 5?  
  
b) Three machines A,B and C produce respectively 60%, 30% and 10% of the total number of items of a factory. The percentages of defective output of these machines are respectively 2%, 3% and 4%. An item is selected at random and is found defective. Find the probability that the item was produced by machine C.
2. a) The cumulative distribution function for a continuous random variable  $X$  is
$$F(x) = 1 - e^{-2x}, x \geq 0$$
$$= 0, x < 0$$
Find (i) the density function  $f(x)$ , (ii) mean and (iii) variance of the density function.  
  
b) A sample of 3 items is selected at random from a box containing 10 items of which 4 are defective. Find the expected number of defective items?
3. a) If the marks obtained by a number of students in a certain subject are approximately normally distributed with mean 65 and standard deviation 5. If three students are selected at random from this group what is the probability that at least one of them would have scored above 75?  
  
b) A part of an air pollution survey an inspector decides to examine the exhaust of 6 of a company's 24 trucks. If the 4 of the company trucks emit excessive amounts of pollutants, what is the probability that none of them will be included in the inspector's sample?
4. a) The mean life of a sample of 10 electric bulbs was found to be 1456 hours with S.D. of 423 hours. A second sample of 17 bulbs chosen from a different batch showed a mean life of 1280 hours with S.D. of 398 hours. Is there a significant difference between the means of two batches?  
  
b) Find 95% confidence limits for the mean of a normality distributed population from which the following sample was taken 15,17,10,18,16,9,7,11,13,14.

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**R10****SET - 3**

5. a) In a study of an automobile insurance a random sample of 80 body repair costs had a mean of Rs.472.36 and the S.D. of Rs.65.35. If  $\bar{X}$  is used as a point estimate to the true average repair costs, with what confidence we can assert that the maximum error doesn't exceed Rs. 10?
- b) In a random sample of 400 industrial accidents, it was found that 231 were due at least partially to unsafe working conditions construct a 99% confidence interval for the corresponding true proportion.
6. a) The IQs (intelligence quotients) of 16 students from one area of a city showed a mean of 107 with a standard deviation of 10, while the IQs of 14 students from another area of the city showed a mean of 112 with a standard deviation of 8. Is there a significant difference between the IQs of the two groups at a 0.05 level of significance?
- b) An instructor has two classes A and B, in a particular subject. Class A has 16 students while class B has 25 students. On the same examination, although there was no significant difference in mean grades, class A has a standard deviation of 9 while class B had a standard deviation of 12. Can conclude at the 0.01 level of significance that the variability of class B is greater than that of A?
7. A process for manufacturer of 4-by-8 foot woodgrained panels has performed in the past with an average of 2.7 imperfections per 100 panels. Construct a chart to be used in the inspection of the panels and discuss the control if 25 successive 100-panel lots contained, respectively 4,1,0,3,5,3,5,4,1,4,0,1,4,2,3,7,4,2,1,3,0,2,6,1 and 3 imperfections.
8. Arrivals at a telephone booth are considered to be Poisson, with an average time of 10 between on arrival and the next. The length of a phone call assumed to be distributed exponentially with mean 3 minutes, then
- (i) What is the probability that a person arriving at the booth will have to wait?
- (ii) What is the average length of the queues that form from time to time?

The telephone department will install a second booth when convinced that an arrival would expect to have waited at least three minutes for the phone. By how much must the flow of arrivals be increased in order to justify a second booth?

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