II B.Tech I Semester Examinations,December 2011
PROBABILITY AND STATISTICS
Common to ME, MECT, MEP, AME, CSE
Time: 3 hours   Max Marks: 75
Answer any FIVE Questions
All Questions carry equal marks
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1. Three boys A, B, C are throwing a ball to each other. A always throws the ball to B; B always throws the ball to C; but C is just as likely to throw the ball to B as to A. Show that the process is Markovian. Find the transition matrix and classify the states. Do all the states are ergodic?   [15]

2. Patients arrive at a clinic in a poisson manner at an average rate of 6 per hour. The doctor on average can attend to 8 patients per hour. Assuming that the service time distribution is exponential, find

   (a) Average number of patients waiting in the queue.

   (b) Average time spent by a patient in the clinic.   [15]

3. For 20 army personal the regression of weight of kidneys (Y) on weight of heart (X) is Y = 399 X+6.394 and the regression of weight of heart on weight of kidneys is X = 1.212 Y + 2.461. Find the correlation coefficient between the two variable and also their means.   [15]

4. (a) A random sample of 500 Apples was taken from a large consignment of 60 were found to be bad, obtain the 98% confidence limits for the percentage number of bad apples in the consignment.

   (b) Among the items produced by a factory out of 500, 15 were defective, in another sample out of 400, 20 were defective. Test the significance between the differences of two proportions at 5% level.   [15]

5. (a) Given that p(x=2)=9p(x=4)+90 p(x=46) for a Poisson variate X. Find:
      i. P(x<2)
      ii. p(x>4)
      iii. $p(x \geq 1)$

   (b) In a Normal distribution exactly 7% of the items are under 35 and 89% are under 63. Find the mean and the Standard deviataion of mark.   [7+8]

6. (a) In 64 randomly selected hours of production, the mean and the standard deviation of the number of acceptance pieces produced by an automatic stamping machine are x = 1.038 and σ = .146.
      At the .05 level of significance does this enable us to reject the null hypothesis μ = 1.000 against the alternative hypothesis μ >1.000?

(b) A comapany claims that its light bulbs are superior to those of its main competitor. If a study showed that a sample of 40 of its bulbs have a mean life time of 647 hrs of continuous use with a S.D of 27 hrs. While a sample of 40 bulbs made by bits main competitor had a mean life time of 638 hrs of continuous use with a S.D of 31 hrs. Test the significance between the difference of two means at 5% level. [7+8]

7. (a) A random sample of six steel beams has a mean compressive strength of 58392 with a standard deviation of 648. Use this information at the level of significance α =0.5 to test whether the true average compressive strength of the steel from which this sample came is 58,000.

(b) For an F- distribution find

   i. $F_{0.05}$ with $\vartheta_1 = 7$ and $\vartheta_2 = 15$
   ii. $F_{0.01}$ with $\vartheta_1 = 24$ and $\vartheta_2 = 19$
   iii. $F_{0.95}$ with $\vartheta_1 = 19$ and $\vartheta_2 = 24$
   iv. F0.99 with $\vartheta_1 = 28$ and $\vartheta_2 = 12$ [15]

8. (a) A coin is biased in a way that a head is twice as likely to occur as a tail. If the coin is tossed 3 times, find the probability of getting 2 tail and 1 head

(b) If X is the continuous random variable whose density function is
$f(x) = x$ if $0 < x < 1$
$\quad$ =(2-x) if $1 \leq x < 2$
$\quad$ = 0, else where
Find $E(25X^2 + 30X - 5)$ [7+8]

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Code No: A109210302   **R09**   **Set No. 4**

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1. (a) The mean height of students in a college is 155 cms and standard deviation is 15. What is the probability that the mean height of 36 students is less than 157 cms.

   (b) Given that the mean height of students in a class is 158 cms with a standard deviation of 20 cms. Find how many students heights lie

      i. Between 150 cms and 170 cms.
      ii. Above 180 cms.   [7+8]

2. A gambler has Rs.2. He bets Rs.1 at a time and wins Rs.1 with probability 0.5. He stops Playing if he looses Rs.2 or wins Rs.4.

   (a) What is the Transition probability matrix of the related markov chain?

   (b) What is the probability that he has lost his money at the end of 5 plays? [15]

3. (a) The number of automobile accidents per week in a certain community are as follows : 12, 8, 20, 2, 14, 10, 15, 6, 9, 4 are these frequencies in agreement with the belief that accident conditions were two same during this 10 week period.

   (b) A die is thrown 264 times with the following results. Show that the die is biased.(Given $X_{0.05}^2$ =11.07 for 5 d.f)   [15]

No. appeared on the die	1	2	3	4	5	6
Frequency	40	32	28	58	54	52

4. (a) A manufacturer claimed that at least 95% of the equipment which he supplied to a factory conformed to specifications. An examination of a sample of 200 pieces of equipments received 80 were faulty. Test the claim at .05 level.

   (b) A machine puts out 9 imperfect articles in a sample of 200 articles. After the Machine is overhauled it puts out 5 imperfect articles in a sample of 700 articles. Test at 5% level whether the Machine is improved?   [15]

5. (a) Given n=10, $\sigma x = 5.4$, $\sigma y = 6.2$ and sum of the product of deviation from the mean of X and Y is 66 find the correlation co-efficient.

   (b) If the two regression lines of y on x and x on y are respectives $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ prove that $a_1 b_2 < _2b_1$ [15]

6. (a) A random sample of 500 points on a heated plate resulted in an average temperature of 73.54 degrees Fahrenheit with a standard deviation of 2.79 degree Fahrenheit. Find a 99% confidence interval for the average temperature of the plate.

3

(b) An aircraft strobe light is designed so that the times between flashes have a mean of 10.15 s and a standard deviation of 0.4 s. Officials at the airport want to check if the strobe light needs adjustment. A sample of 50 times is randomly selected and the mean time between flashes is 9.87 Use the 5% level of significance.   [7+8]

7. Consider a box office ticket window being manned by a single server. Customer arrive to purchase tickets according to poisson input process with a mean rate of 30 per hour. The time required to serve a customer has an exponential distribution with a mean of 910 seconds. Determine the following.

   (a) Fraction of the time the server is busy.

   (b) The average number of customers queuing for service.   [15]

8. (a) If A,B and C are three events prove that
   $P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(A \cap B)$
   $-P(B \cap C) P(C \cap A) + P(A \cap B \cap C)$

   (b) For the discrete probility distribution

x	0	1	2	3	4	5	6	7
f	0	k	2k	2k	3K	k^2	$2k^2$	$7k^2+k$

   Determine:

   (a) K

   (b) mean

   (c) variance.   [8+7]

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1. (a) A can hit a target 4 in 5 shots. B can hit 3 among 4. C can hit 2 among 3. What is the probability that at least two shots hit the target.

   (b) A continous Random variable has the p.d.f $f(x) = Kxe^{-\lambda x}$ If $x \geq 0, \lambda \geq 0$ Determine:

      i. K
      ii. The mean
      iii. variance.   [7+8]

2. (a) Explain student t-distribution, its properties and applications.

   (b) A random sample of size 25 from a normal population has the mean $\ddot{X}$ =47.5 and the standard deviation S=8.4. Does this information tend to support or refute the claim that the mean of the population is μ =42.5.   [15]

3. (a) If 2% of light bulbs are defective. Find

      i. At least one is defective.
      ii. Exactly 7 are defective
      iii. P(1<x<8) in a sample of 100

   (b) A random sample of size 64 is taken from an infinite population having the mean 45 and the Standard deviation 8. What is the probability that $\overline{x}$ will be between 46 and 47.5.   [7+8]

4. Define the stochastic matrix which of the following stochastic matrices are regular.   [15]

   (a) $\begin{bmatrix} 1/2 & 1/4 & 1/4 \\ 0 & 1 & 0 \\ 1/2 & 0 & 1/2 \end{bmatrix}$

   (b) $\begin{bmatrix} 2 & 1/2 & 0 \\ 1/2 & 1/2 & 0 \\ 1/4 & 1/4 & 1/2 \end{bmatrix}$

5. Calculate coefficient of correlation between age of cars and annual maintenance and comment.   [15]

Age of cars (years)	2	4	6	7	8	10	12
Annual maintenance cost (rupees)	1600	1500	1800	1900	1700	2100	2000

6. (a) A sample of 400 items is taken from a population whose standard deviation is 10. The mean of the sample is 40. Test whether the sample has come from a population with mean 38. Also calculate4 95% confidence interval.

   (b) Studying the flow of traffic at two busy intersections between 4 p.m and 6 p.m to determine the possible need for turn signals. It was found that on 40 week days there were on the average 247.3 cars approaching the first intersection from the south which made left turn, while on 30 week days there were on the average 254.1 cars approaching the first intersection from the south made left turns.
   The corresponding sample standard deviations are 15.2 and 12. Test the significance between the difference of two means at 5% level. [7+8]

7. At a one man barber shop, customers arrive according to poisson distribution with a mean arrival rate of 5 per hour and the hour cutting time is exponentially distributed, with an average hair cut taking 10 minutes. It is assumed that because of his excellent reputation customers are always willing to wait. Calculate.

   (a) Average number of customers in the shop.

   (b) Average number of customers waiting for hair cut.

   (c) The percent of time on arrival can walk right in without waiting.

   (d) The percent of customers who have to wait prior to getting into the barber's chair. [15]

8. (a) A manufacturer claims that at least 95% of the equipment which he supplies to a factory conforms to specifications. An examination of a sample of 200 pieces of the equipment revealed that 18 were faulty. Test the claim at a significant level of 0.05.

   (b) Random samples of 400 men and 200 women in a locality were asked whether they would like to have a bus stop near their residence. 200 men and 40 women were in favour of the proposal. Test the significance between the difference of two proportions at 5% level. [15]

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Set No. 3

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1. (a) Among 100 fish caught in a large lake, 18 were inedible due to the pollution of the environment. With what confidence can we assert that the error of this estimate is at most .065?

   (b) A machine puts out 16 imperfect articles in a sample of 500 articles. After the Machine is overhauled it puts out 3 imperfect articles in a sample of 100 articles. Has the Machine improved? [15]

2. Given n=10, σ x = 4.5, σ y = 3.6 and sum of the product of deviation from the mean of X and Y is 64 find the correlation co-efficient. [15]

3. (a) Check whether the following marker chain is regular and ergodic?
$$\begin{bmatrix} 1 & 1/2 & 1/2 & 0 \\ 1/2 & 0 & 0 & 1/2 \\ 1/2 & 0 & 0 & 1/2 \\ 0 & 1/2 & 1/2 & 1/2 \end{bmatrix}$$

   (b) The transition probability matrix of a marker chain is given by $\begin{bmatrix} 0.3 & 0.7 & 0 \\ 0.1 & 0.4 & 0.5 \\ 0 & 0.2 & 0.8 \end{bmatrix}$

   verify whether the matrix is irreducible or not? [15]

4. Consider a self servie store with one cashier. Assume poisson arrivals and exponential service time. Suppose that a customers arrive on average of every 5 minutes and the cashier can serve in 5 minutes. Find:

   (a) The average number of customers queuing for service.

   (b) The probability of having more than 10 customers in the system.

   (c) The probability that the customer has to queue for more than 2 minutes. [15]

5. (a) If the Mean of a Poisson variable is 1.8, then find

   i. $p(x > 1)$
   ii. p(x=5)
   iii. p(0<x<5)

   (b) If the masses of 300 students are normally distributed with mean 68 kgs and standaard deviation 3kgs how many students have masses.

   i. Greater than 72 kgs
   ii. Less than or equal to 64 kg

iii. Between 65 and 71 kg inclusive [7+8]

6. (a) The average losses of workers, before and after certain pro are given. Use 0.05 level of significance to test whether the program is effective (paired sample t-test).
40 and 35, 70 and 65, 45, -42, 120 and 116, 35 and 55 and 50, 77 and 73.

(b) The table gives the biological values of protein from 6 cow's milk and 6 buffalo's milk. Examine whether the differences are significant. [15]

Cow's milk	1.8	2.0	1.9	1.6	1.8	1.5
Buffalo's milk	2	1.8	1.8	2.0	2.1	1.9

7. (a) Prove that for a random sample of size n, n, X_1, X_2........X_n taken from a finite population $s^2 = \frac{1}{n} \sum_{i-1}^{n} \left(X_i - \overline{X} \right)^2$ is not unbiased estimator of the parameter σ^2 but $\frac{1}{n} \sum_{i-1}^{n} \left(X_i - \overline{X} \right)^2$ is unbiased.

(b) A sample of 100 iron bars is said to be drawn from a large number of bars. Whose lengths are normally distributed with mean 4 feet and S.D..6 ft. If the sample mean is 4.2 feet can the sample be regarded as a truly random sample? [8+7]

8. (a) There are six boxes, of which two are round and four are square. Each round box contains two green marbles and three blue marbles. Each square box contains one green marble and three blue marbles. A box is chosen at random and a marble is chosen at random from it. If the marble is blue, what is the probability that it is from

i. Round box
ii. Square box.

(b) Find the mean and the variable of uniform probability distribution given by $f(x) = \frac{1}{n}$ for x=1,2,3,4,..........n [7+8]

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