

II B.Tech. II Semester Regular Examinations, April/May -2005**PROBABILITY AND STATISTICS**

(Common to Civil Engineering, Mechanical Engineering, Computer Science & Engineering, Chemical Engineering, Information Technology, Mechatronics, Computer Science & Systems Engineering, Electronics & Computer Engineering, Production Engineering and Bio-Technology)

Time: 3 hours**Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

1. (a) For any three arbitrary events A,B,C , 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) In a certain town 40% have brown hair, 25% have brown eyes and 15% have both brown hair and brown eyes. A person is select at random from the town
 - i. If he has brown hair, what is the probability that he has brown eyes also
 - ii. If he has brown eyes, determine the probability that he does not have brown hair
2. (a) For the continuous probability function $f(x) = kx^2 e^{-x}$ when $x \geq 0$,
- (b) 20% of items produced from a factory are defective. Find the probability that in a sample of 5 chosen at random.
3. (a) If a Poisson distribution is such that $P(x=1) \cdot \frac{3}{2} = P(x=3)$. Find
 - i. $p(x \geq 1)$
 - ii. $p(x \leq 3)$
 - iii. $p(2 \leq x \leq 5)$
- (b) A sales tax officer has reported that the average sales of the 500 business that he has to deal with during a year is Rs.36,000 with a standard deviation of 10,000. Assuming that the sales in these business are normally distributed, find
 - i. the number of business as the sales of while are Rs.40,000/-
 - ii. the percentage of business the sales of while are likely to range between Rs. 30,000/- and Rs.40,000/-
4. (a) Write about
 - i. Null hypothesis
 - ii. Type 1 & type II errors.
- (b) According to the norms established for a mechanical aptitude test, persons who are 18 years old have an average height of 73.2 with a standard deviation of 8.6. If 45 randomly selected persons of that age averaged 76.7. Test the null hypothesis $\mu = 73.2$ against the alternative hypothesis $\mu \neq 73.2$ at the .01 level of significance.

5. (a) A random sample of size 100 has a standard deviation of 5. What can you say about the maximum error with 95% confidence.
- (b) Among 900 people in a state 90 are found to be chapatti eaters. Construct 99% confidence interval for the true proportion.
- (c) A random sample of 1200 apples was taken from a large consignment and found that 10% of them are bad. The supplier claims that only 2% are bad. Test his claim at 95% level.
6. Two independent samples of sound 7 items respectively had the following values.

Sample I	11	11	13	11	15	9	12	14
Sample II	9	11	10	13	9	8	10	-

In the difference between the means of samples significant?

7. (a) The following data pertain to the number of computer jobs per day and the required CPU time required:

Number of Jobs

X 1 2 3 4 5

CPU time

Y 2 5 4 9 10

Fit a least square line to estimate the mean CPU time and using it estimate the CPU time at $x = 3.5$.

- (b) Fit a parabola of the form $y = a_0 + a_1x + a_2x^2$ to the following data: by the method of least squares and estimate y at $x=7.5$.

x	1	2	3	4	5	6	7	8	9	10
y	1.28	1.53	1.03	0.81	0.74	0.65	0.87	0.81	1.10	1.03

The method of least squares and estimate Y at $X = 7.5$

8. The following are the data on the number of twists required to break a certain kind of forged alloy bar and the percentage of two alloying elements present in the metal. Fit a least sequence regression line of on x_1 and x_2

No.of turists	(y)	41	49	69	65	40	50	58	57	31	36	44	57	19	31	33	43
% of elements of A	(x_1)	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
% of elements of B	(x_2)	5	5	5	5	10	10	10	10	15	15	15	15	20	20	20	20

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1. (a) Define a random experiment, sample space, event and mutually exclusive events. Give examples of each.
(b) Box A contains 5 red and 3 white marbles and box B contains 2 red and 6 white marbles.
 - i. If a marble is drawn from each box, what is the probability that they are both of the same color?
2. (a) Define random variable, discrete probability distribution, continuous probability distribution and cumulative distribution. Give an example of each.
(b) Assume that 50% of all engineering students are good in mathematics. Determine the probabilities that among 18 engineering students
 - i. exactly 10
 - ii. at least 10
 - iii. at most 8
 - iv. at least 2 and at most 9 , are good in mathematics.
3. (a) If a Poisson distribution is such that $P(x=1) \cdot \frac{3}{2} = P(x=3)$. Find
 - i. $p(x \geq 1)$
 - ii. $p(x \leq 3)$
 - iii. $p(2 \leq x \leq 5)$(b) A sales tax officer has reported that the average sales of the 500 business that he has to deal with during a year is Rs.36,000 with a standard deviation of 10,000. Assuming that the sales in these business are normally distributed, find
 - i. the number of business as the sales of while are Rs.40,000/-
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4. (a) A random sample of 6 steel beams has a mean compressive strength of 58,392 p.s.i. (pounds per square inch) with a standard deviation of 648 p.s.i. Use this information at the level of significance $\alpha = 0.025$ to test whether the true average compressive strength of steel from which this sample came is 58,000 p.s.i. Assume normality?

- (b) Measuring specimens of nylon yarn taken from two machines, it was found that 8 specimens from 1st machine had a mean denier of 9.67 with a standard deviation of 1.81 while 10 specimens from a 2nd machine had a mean denier of 7.43 with a standard deviation 1.48. Assuming the population are normal test the hypothesis $H_0 : \mu_1 - \mu_2 = 1.5$ against $H_1 : \mu_1 - \mu_2 > 1.5$ at 0.05 level of significance?
5. Ten soldiers participated in a shooting competition in the first week. After intensive training they participated in the competition in the second week. Their scores before and after training given as follows.

Scores before	67	24	57	55	63	54	56	68	33	43
Scores after	70	38	58	58	56	67	68	75	42	38

Do the data indicate that the soldiers have been benefited by the training.

6. Measurements of the fat content of two kinds of ice creams Brand A and brand B yielded the following sample data.

Brand A	13.5	14.0	13.6	12.9	13.0
Brand B	12.9	13.0	12.4	13.5	12.7

Test the significant between the means at 0.05 level.

7. (a) Derive normal equations to fit a parabola $y = a_0 + a_1x + a_2x^2$
 (b) Fit the curve $y = ae^{bx}$ for the following data

x	1	5	7	9	12
y	10	15	12	15	21

8. Two independent variables x and y have means 5 and 10 and variances 4 and 9 respectively. Find the coefficient of correlation between u and v where
- (a) $u = 3x+4y$, $v = 3x-y$
 (b) If x and y are not independent and $r=.5$, $u = x+y$, $v = x-y$

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1. (a) Two marbles are drawn in succession from a box containing 10 red, 30 white, 20 blue and 15 orange marbles, with replacement being made after each drawing.. Find the probability that
 - i. both are white
 - ii. first is red and second is white
- (b) A businessman goes to hotels X,Y,Z 20%, 50%, 30% of the time respectively. It is known that 5%, 4%, 8% of the rooms in X,Y,Z hotels have faulty plumbing. What is the probability that business mans room having faulty plumbing is assigned to hotel Z.
2. (a) If X and Y are discrete random variables and K is a constant then prove that.
 - i. $E(X + K) = E(X) + K$
 - ii. $E(X+Y) = E(X) + E(Y)$
- (b) Out of 800 families with 5 childrens each, how many would you expect to have
 - i. 3 boys
 - ii. either 2 or 3 boys
3. (a) If a Poisson distribution is such that $P(x=1) \cdot \frac{3}{2} = P(x=3)$. Find
 - i. $p(x \geq 1)$
 - ii. $p(x \leq 3)$
 - iii. $p(2 \leq x \leq 5)$
- (b) A sales tax officer has reported that the average sales of the 500 business that he has to deal with during a year is Rs.36,000 with a standard deviation of 10,000. Assuming that the sales in these business are normally distributed, find
 - i. the number of business as the sales of while are Rs.40,000/-
 - ii. the percentage of business the sales of while are likely to range between Rs. 30,000/- and Rs.40,000/-
4. A population consists of five numbers 2,3,6,8,11. Consider all possible samples of size two which can be drown without replacement from the population. Find

- (a) The mean of the population
 (b) Standard deviation of the population.
 (c) The mean of the sampling distribution of means
 (d) The standard deviation of the sampling distribution of means.
5. (a) Experiences had shown that 20% of a manufactured product is of the top quality. In one days production of 400 articles only 50 are of top quality. Test the hypothesis at .05 level.
 (b) Ten bearings made by a certain process have a mean diameter of 0.5060 cm with a standard deviation of 0.0040 cm. Assuming that the data may be looked upon as a random sample from a normal distribution, construct a 95% confidence interval for the actual average diameter of the bearings?
6. (a) The following data gives the fields of interest and attitude to religion:

	Arts and Commerce	Science and Engineering	Total
Conformist	109	51	160
Non-Conformist	23	17	
Total	132	68	200

Examine whether the field of interest and attitude to religion are associated.

- (b) Assuming tht $\sigma = 20.0$, how large a random sample be taken to assert with probability 0.95 that the sample mean will not differ from the true mean by more than 3.0 points?
7. (a) The following data pertain to the cosmic ray doses measured at various altitudes:
- | | | | | | | | |
|-----------|----|-----|-----|------|------|------|------|
| Altitude | | | | | | | |
| (Feet x) | 50 | 450 | 780 | 1200 | 4400 | 4800 | 5300 |
| Dose Rate | | | | | | | |
| (year y) | 28 | 30 | 32 | 36 | 51 | 58 | 69 |
- Fit a straight lines $y = a + bx$
- (b) Derive normal equations to fit the parabola $y = a + b x + cx^2$
8. (a) A sample of 12 fathers and their eldest sons gave the following data about their height in inches calculate the coefficient of rank correlation.
 (b) Given that $x = 4y + 5$ and $y = kx + 4$ are the regression lines of x on y and y on x, respectively, show that $0 \leq k \leq 25$. If $k = 0.10$ actually, find the means of the variables c and y and also their coefficient of correlation.

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1. (a) Prove that
 - i. $P(A^c) = 1 - P(A) \leq 1$.
 - ii. $P(B) \leq P(A)$ when $B \subset A$
- (b)
 - i. 3 boys are selected
 - ii. exactly 2 girls are selected
2. (a) Let $F(x)$ be the distribution function of a random variable X given by

$$\begin{aligned}
 F(x) &= cx^3 \quad \text{when } 0 \leq x < 3 \\
 &= 1 \quad \text{when } x \geq 3 \\
 &= 0 \quad \text{when } x < 0.
 \end{aligned}$$

If $P(X=3) = 0$ Determine

- i. c
 - ii. mean
 - iii. $P(x > 1)$
- (b) A student takes a true false examination consisting of 8 questions. He guesses each answer. The guesses are made at random. Find the smallest value of n that the probability of guessing at least n correct answers is less than $\frac{1}{2}$
3. (a) Using recurrence formula find the probabilities when $x=0, 1, 2, 3, 4$ and 5 : If the mean of Poisson distribution is 3.
- (b) If the masses of 300 students are normally distributed with mean 68kgs and standard deviation 3kgs how many students have masses.
 - i. Greater than 72kg
 - ii. Less than or equal to 64kg
 - iii. Between 65 and 7kg inclusive
4. A population consists of five numbers 2,3,6,8,11. Consider all possible samples of size two which can be drawn without replacement from the population. Find
 - (a) The mean of the population

- (b) Standard deviation of the population.
- (c) The mean of the sampling distribution of means
- (d) The standard deviation of the sampling distribution of means.
5. (a) The mean and the standard deviation of a population are 11,795 and 14054 respectively. If $n=50$, find 95% confidence interval for the mean
- (b) In a city 250 men out of 750 were found to be smokers. Does this information support the conclusion that the majority of men in this city are smokers.
6. (a) A firm manufacturing rivets wants to limit variation in their length as much as possible. The lengths (in cms.) of 10 rivits manufactured by a new process are

2.15	1.99	2.05	2.12	2.17
2.01	1.98	2.03	2.25	1.93

Examine whether the new process can be considered superior to the old if the old population has standard deviation 0.145 cm.?

- (b) The following are the average weekly losses of worker hours due to accidents in 10 industrial plants before and after a certain safety programme was put into operation:

Before:	45	73	46	124	33	57	83	34	26	17
After :	36	60	44	119	35	51	77	29	24	11

Test whether the safety programme is effective in reducing the number of accidents at the level of significance of 0.05?

7. (a) Derive normal equations to fit the parabola $y = a_0 + a_1x + a_2x^2$
- (b) Fit the parabola $y = a_0 + a_1x + a_2x^2$ for the following data

X	0	1	2	3	4
Y	1	1.8	1.3	2.5	6.3

8. Two independent variables x and y have means 5 and 10 and variances 4 and 9 respectively. Find the coefficient of correlation between u and v where
- (a) $u = 3x+4y$, $v = 3x-y$
- (b) If x and y are not independent and $r=.5$, $u = x+y$, $v = x-y$

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