

II B.Tech II Semester Regular Examinations, Apr/May 2006**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, Bio-Technology and Automobile Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

1. (a) If A and B are any two arbitrary events of the sample space then Prove that $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
- (b) Determine the probability for each of the following events:
 - i. a non defective bolt will be found if out of 600 bolts already examined 12 were defective.
 - (c) Two digits are selected at random from the digits 1 through 9.
 - i. If the sum is odd, what is the probability that 2 is one of the numbers selected.
 - ii. If 2 is one of the digits selected, what is the probability that the sum is odd [5+5+6]
2. (a) If X is a continuous random variable and K is a constant then prove that
 - i. $\text{Var}(X+K) = \text{Var}(X)$
 - ii. $\text{Var}(kX) = k^2 \text{Var}(X)$
- (b) The probability of a man hitting a target is $1/3$.
 - i. If he fires 5 times, what is the probability of his hitting the target at least twice
 - ii. How many times must he fire so that the probability of his hitting the target at least once is more than 90%. [8+8]
3. (a) The average number of phone calls/minute coming into a switch board between 2 p.m. and 4. p.m. is 2.5. Determine the probability that during one particular minute there will be
 - i. 4 or fewer
 - ii. more than 6 calls
- (b) The marks obtained in mathematics by 1000 students is normally distributed with mean 78% and standard deviation 11%. Determine
 - i. how many students got marks above 90%
 - ii. what was the highest mark obtained by the lowest 10% of the student
 - iii. within what limits did the middle of 90% of the students lie [8+8]

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? [8+8]
5. (a) In a random sample of 160 workers exposed to a certain amount of radiation, 24 experienced some ill effects. Construct a 99% confidence interval for the corresponding ture percntage.
- (b) What is the size of the sample required to estimate an unknown proportion to with a maximum error of 0.06 with at least 5% confidence given that Standarand deviation is 2 ?
- (c) The performance of a computer is observed over a period of 2 years to check the claim that the probability is 0.20 that its downtime kwill exceed 5 hours in any given week. Testing the null hypothesis $P = 0.20$ against the alternate hypothesis $P \neq 0.20$, what can we conclude at the level of significance $\alpha = 0.05$, if there were only 11 weeks in which the downtime of the computer exceeded 5 hours? [5+5+6]
6. A pair of dice are thrown 360 times and the frequency of each sum is indicated below:

Sum	2	3	4	5	6	7	8	9	10	11	12
Frequency	8	24	35	37	44	65	51	42	26	14	14

Would you say that the dice are fair on the basis of the chi-square test at .05 level of significance. [16]

7. (a) Fit a straight line $y = a_0 + a_1x$ for the following data and estimate the value of y when x=25.

x	0	5	10	15	20
y	7	11	16	20	26

- (b) Fit a curve of the form $y = ax^b$ by the method of least squares for the following data

x	1	2	3	4	5
y	5	2	4.5	8	12.5

[8+8]

8. (a) If there are no ties in the ranks then show that the rank correlation is given be $\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$ where $d_i = \text{rank of } x_i - \text{rank of } y_i$

- (b) For 20 army personnel, the regression of weight of kidneys (y) on weight of heart (x), both measured in oz, is $y = 0.399x + 6.394$ and the regression of weight of heart on weight of kidneys is $x = 1.212y - 2.461$. Find the correlation coefficient between the two variables and also their means. [8+8]

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1. (a) If A and B are events with $P(A) = 1/3$, $P(B) = 1/4$, and $P(A \cup B) = 1/2$, find
 - i. $P(A/B)$
 - ii. $P(A \cap B^c)$
- (b) Three students A,B,C are in a running race. A and B have the same probability of winning and each is twice as likely to win as C. Find the probability that B or C wins.
- (c) The students in a class are selected at random one after the other for an examination. Find the probability that the boys and girls are alternate if there are
 - i. 5 boys and 4 girls
 - ii. 4 boys and 4 girls. [6+5+5]

2. (a) Calculate expectation and variance of x, if the probability distribution of the random variable x is given by

X	-1	0	1	2	3
f	0.3	0.1	0.1	0.3	0.2

- (b) Determine the probability of getting 9 exactly twice in 3 throws with a pair of fair dice. [8+8]
3. (a) Find the mean of the normal distribution .
 - (b) Suppose the weights of 800 male students are normally distributed with mean $\mu = 140$ pounds and standard deviation 10pounds. Find the number of students whose weights are
 - i. between 138 and 148pounds
 - ii. more than 152pounds [8+8]
4. (a) The mean of certain normal population is equal to the standard error of the mean of the samples of 64 from that distribution. Find the probability that the mean of the sample size 36 will be negative.

- (b) A sample of 64 students have a mean weight of 70kgs. Can this be regarded as a sample from a population with mean weight 65kgs and standard deviation 25kgs. [8+8]
5. (a) In a random sample of 125 cola drinkers, 68 said they prefer thums up to pepsi. Test the null hypothesis $p = .5$ against the alternate hypothesis $p > .5$
- (b) A random sample of 100 teachers in a large metropolitan area revealed a mean weekly salary of Rs. 487 with a standard deviation Rs. 48. With what degree of confidence can we assert that the average weekly salary of all teachers in the metropolitan area is between 472 to 502? [8+8]
6. (a) Four methods are under development for making discs of a super conducting material. Fifty discs are made by each method and they are checked for super conductivity when cooled with liquid.

	1 st Method	2 nd Method	3 rd Method	4 th Method
Super Conductors	31	42	22	25
Failures	19	8	28	25

- (b) Test the significant difference between the proportions of Superconductors at .05 level, 20 From the following data find whether there is any significant liking in the habit of taking soft drinks among the categories of employees.

		Employees	
Soft drinks	Clerks	Teachers	Officers
Pepsi	10	25	65
Thums up	15	30	65
Fanta	50	60	30

[8+8]

7. (a) Derive normal equations to fit $y = ax^b$
- (b) Fit a parabola of the form $y = a + bx + cx^2$ for the following data

x	2	4	6	8	10
y	3.07	12.85	31.47	57.38	91.29

[6+10]

8. (a) The following table gives experimental values of the three variates X,Y and Z. Fit a multiple regression of the type $Z = \alpha X + \beta Y$.

X	1	2	3	5
Y	1	3	4	2
Z	7	18	25	23

- (b) The following are the marks obtained by 12 students in Economics and Statistics:

Economics(x)	78	56	36	66	25	75	82	62
Statistics(y)	84	44	51	58	60	68	62	58

Compute the Spearman rank correlation coefficient between x and y [8+8]

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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? [8+8]
2. (a) Let X denote the minimum of the two numbers that appear when a pair of fair dice is thrown once. Determine the
 - i. discrete probability distribution
 - ii. expectation
 - iii. variance.(b) Show that if p is small and n is large, then the binomial distribution $B(n,p)$ is approximated by the Poisson distribution. [8+8]
3. (a) 2% of the items of a factory are defective. The items are packed in boxes. What is the probability that there will be
 - i. 2 defective items
 - ii. at least three defective items(b) The marks obtained in statistics in a certain examination found to be normally distributed. If 15% of the marks of the students ≥ 60 , 40% < 30 marks, find the mean and standard deviation. [8+8]
4. (a) A normal population has a mean of 1 and standard deviation of 2:1. Find the probability that the mean of simple sample of 900 members will be negative.
(b) It is claimed that a random sample of 100 types with a mean life of 15269 is drawn from a population of tyres which has a mean life of 15200 km and a standard deviation of 1248km, test the validity of his claim. [8+8]
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. [8+8]
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? [8+8]

7. (a) The measurements of humidity and the moisture content in a raw material are given in the following table. Fit a St. line of the for $y = ax + b$

(X) 42 35 50 43 48 62 31 36 44 39 55 48
(Y) 12 8 14 9 1 16 7 9 12 10 13 11

- (b) By the method of least squares, fit the curve of the form $y = ae^{bx}$ for the following data.

x	0.0	.5	1.0	1.5	2.0	2.5
y	0.10	.45	2.15	9.15	40.35	180.75

[8+8]

8. Find the least sequences regression equation of x_1 on x_2 and x_3 from the following data.

X_1	3	5	6	8	12	14
X_2	16	10	7	4	3	2
X_3	90	72	54	42	30	14

[16]

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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. [8+8]
2. (a) If a random variable has the probability density $f(x) = 2 e^{-2x}$ for $x > 0$
 $= 0$ for $x \leq 0$
 Find the probabilities that it will take on a value
 - i. between 1 and 3
 - ii. greater than .5
- (b) Let X denote the number of heads in a single toss of 4 fair coins. Determine
 - i. $P(X < 2)$
 - ii. $P(1 < x \leq 3)$. [8+8]
3. (a) Define Poisson distribution and find its variance and the mean.
- (b) Find the mean and standard deviation of a normal distribution in which 7% of items are under 35 and 89% are under 63. [8+8]
4. (a) A random sample of size 144 is taken from an infinite population having the mean 75 and variance 225. What is the probability that \bar{x} will lie between 72 and 77?
- (b) It is claimed that a random sample of 49 tyres is a mean life of 15200km. This sample was drawn from a population whose mean is 15150kms and a standard deviation of 1200km. Test the significance at 0.5 level. [8+8]
5. (a) In a random sample of 400 industrial accidents, it was found that 231 were due atleast partially to unsafe working conditions. Construct a 99% percent confidence interval for the corresponding true proportion?

- (b) Two horses A and B were tested according to the time (in seconds) to run a particular track with the following results.

Horse A	28	30	32	33	33	29	34
Horse B	29	30	30	24	27	29	

Test whether the two horses have the same running capacity. [8+8]

6. (a) It is desired to estimate the mean number of hours of continuous use until a certain computer will first require repairs. If it can be assumed that $\sigma = 48$ hours, how large a sample be needed so that one will be able to assert with 90% confidence that the sample mean is off by at most 10 hours?
- (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? [8+8]

7. (a) Fit the curve $y = ae^{bx}$ to the following data

x:	0	1	2	3	4	5	6	7	8
y:	20	30	52	77	135	211	326	550	1052

- (b) Fit a second degree polynomial to the following data, taking x as independent variable:

x:	1	2	3	4	5	6	7	8	9
y:	2	6	7	8	10	11	11	10	15

8. The following data relate to the marks of 10 students in the internal test and the university examination for the maximum of 50 each

Internal marks (x)	25	28	30	32	35	36	38	39	42	45
University marks (y)	20	26	29	30	25	18	26	35	35	46

Find the coefficient of correlation and the two lines of regression. [16]
