

II B.Tech II Semester Examinations, APRIL 2011
PROBABILITY AND STATISTICS
Common to Civil Engineering, Chemical Engineering, Information
Technology

Time: 3 hours

Max Marks: 75

Answer any FIVE Questions
All Questions carry equal marks

1. (a) From the following data calculate.
 - i. Correlation coefficient
 - ii. Standard deviation of y (σ_y)
$$b_{xy} = \frac{9}{20}, b_{yx} = \frac{4}{5}; \sigma_x = 3$$
- (b) Given that $X = 4y + 5$ and $Y = kx + 4$ are the lines of regression of X on Y and Y on X respectively show that $0 < 4k < 1$. If $K = \frac{1}{16}$, find the means of the two variables and coefficient of correlation between them. [15]
2. Explain how to find the probabilities of gambler rein? [15]
3. (a) Among 100 fish caught in a large take, 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]
4. (a) What is the maximum error one can expect to make with probability 0.9, when using mean of a random sample of size $n=64$ to estimate the mean of a population with $\sigma^2 = 2.56$?
- (b) In a certain factory there are 2 independent processes for manufacturing the same item. The average weight in a sample of 250 items produced from one process is found to be 120 gms. With a S.D. of 12 gms while the corresponding figures in a sample of 400 items the other process are 124 and 14. Is there significant difference between the means? [7+8]
5. Compare the prices of a certain product in two cities ten shops were selected at random in each town. The prices noted are given below.

City I	61	52	56	63	56	63	58	56	44	61
City II	55	54	47	59	51	61	57	54	64	58

Test whether the average prices can be said to be same in the two cities. [15]

6. (a) The probability that john hits a target is $\frac{1}{2}$. He fires 6 times. Find the probability that he hits the target:
 - i. Exactly 2 times

- ii. More than 4 times
 - iii. At least once
- (b) The mean inside diameter of a sample of 200 washers produced by a machine is 500 cms with standard deviation .005 cms. The purpose of which these washers are intended a maximum tolerance in the diameter 0.495 to 0.505 cms, otherwise the washers are considered to be defective. Determine the percentage of defective washers. [7+8]
7. (a) There are three boxes. Box I contains 10 light bulbs of which 4 are defective. Box II contains 6 light bulbs of which one is defective. Box III contains 8 light bulbs of which 3 are defective. One box is chosen and a bulb is drawn. Find the probability that the bulb is non defective.
- (b) Box A contains nine cards numbered 1 to 9 and box B contains five cards numbered 1 to 5. A box is chosen at random and a card is drawn. If the card shows an even number another card is drawn from the same box. If the card shows an odd number a card is drawn from the other box. [8+7]
8. A maintenance service facility has poisson arrival rates, negative exponential service time and operates and first come first served queue discipline. Breakdowns occur on an average of three per day with a range of zero to eight. The maintenance crew can service on an average six machines per day with arrange 0 to 7 find.
- (a) Utilization factor of the service facility.
 - (b) Mean time in the system.
 - (c) Mean number in the system in breakdown (or) repair
 - (d) Mean waiting time in the queue
 - (e) Probability of finding two machines in the system.
 - (f) Expected number in the queue. [15]

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1. (a) 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 0.05 level of significance?

- (b) The following table gives the classification of 100 work according to sex and nature of work. Test whether the nature of work is independent of the sex of the worker. [15]

	Stable	Unstable	Total
Males	40	20	60
Females	10	30	40
	50	50	100

2. Patients arrive at a clinic according to a poisson distribution at the rate of 30 patients per hour. The waiting room does not accommodate more than 13 patients not including the one i.e. examine. Examination time per patient is exponential with mean rate 20 per hour.

- (a) Find the effective arrival rate at the clinic.
 (b) What is the probability that an arriving patient will not wait. What is the probability that he finds a vacant seat in the room.
 (c) What is the expected waiting until the patient is discharged from the clinic? [15]

3. 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 loses 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]

4. Find Karl pearson's correlation co-efficient for the following paired data. [15]

Wages	100	101	102	102	100	99	97	98	96	95
Cost of living	98	99	99	97	95	92	95	94	90	91

5. (a) In a sample of the safety explosive used in certain mining operations explosives containing potassium nitrate were found to be used in 95 of 250 cases. What can we say, with 95% confidence about the maximum error?

- (b) 500 articles from a factory are examined and 5% are found to be defective. 800 similar articles from a second factory are found to be 3% defective. Test the significance between the difference of two proportions at 2% level. [15]
6. (a) If the Mean of a Poisson variable is 1.8, then find
- $p(x > 1)$
 - $p(x=5)$
 - $p(0 < x < 5)$
- (b) If the masses of 300 students are normally distributed with mean 68 kgs and standard deviation 3kgs how many students have masses.
- Greater than 72 kgs
 - Less than or equal to 64 kg
 - Between 65 and 71 kg inclusive [7+8]
7. (a) Define:
- An event
 - Mutually exclusive events.
If $A_1, A_2, A_3, \dots, A_n$ are n events, then prove that
$$P\left(\bigcap_{i=1}^n A_i\right) \geq \sum_{i=1}^n P(A_i) - (n - 1)$$
- (b) A sample of 4 items is selected at random from a box containing 12 items of which 5 are defective find the expected number of defective items [7+8]
8. (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 is 48 hours. How large the sample will 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) A sample of 155 members has a mean 67 and S.D 5.2. Is this sample has been taken from a large population of mean 70? [7+8]

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1. (a) 30% of items from a factory are defective. Find the probability that in a sample of 8
 - i. one
 - ii. At least two
 - iii. $p(1 < x < 6)$ are defective(b) Six cards are drawn from a pack of 52 cards. Find the probability that
 - i. At least 3 are diamonds
 - ii. only 4 are diamonds
 - iii. none is a diamond [7+8]
2. (a) Two dice are thrown. Let A be the event that the sum on the faces is 9. Let B be the event that at least one is 6. Find:
 - i. $P(A \cap B)$
 - ii. $P(A \cup B)$
 - iii. $P(A^c \cap B)$
 - iv. $P(A \cap B^c)$(b) A continuous Random variable has the p.d.f $f(x) = K + x/6$, If $0 < x < 3$,
 $= 0$ otherwise
Determine:
 - i. K
 - ii. the mean
 - iii. variance [7+8]
3. (a) A sample of 900 members has a mean 3.4 cms and S.D. 2.61 cms. Is this sample has been taken from a large population of mean 3.25 cms and S.D. 2.61 cms. If the population is normal and its mean is unknown. Find the 95% confidence limits of the true mean?
(b) In a certain factory there are two independent processes for manufacturing the same item. The average weight in a sample of 250 items produced from one process is found to be 120 gms with a S.D of 12 gms. While the corresponding figures in a sample of 400 items from the other process are 124 and 14. Test the significance between the difference of two means 5% level. [7+8]

4. (a) A social worker believes that fewer than 25% of the couples in a certain area are ever used any form of birth control. A random sample of 120 couples was contacted. Twenty of them said they had used some method of birth control. Test belief of social worker at .05 level.
- (b) In a large city 12 out of a random sample of 400 men were found to be drunkards. After the heavy increase in tax on intoxicants another random sample of 200 men in the same city included 8 drunkards. Was the observation decrease in the proportion of drunkards, after the increase of tax. [15]
5. Cars arrive at a petrol pump with exponential inter arrival times having mean $1/2$ minute. The attendant takes an average of $1/5$ minutes per car to supply the petrol, the service time being exponentially distributed. Determine
- (a) The average number of cars waiting to be served.
- (b) The average number of cars in the system.
- (c) The proportion of time for which the pump attendant is idle. [15]
6. (a) A sample of 26 bulbs gives a mean life of 990 hours with a S.D of 20 hours. The manufacturer claims that the mean life of bulbs is 1000 hours. Is the sample not upto the standard.
- (b) A random sample of 10 boys had the following I.Q's 70, 120, 110, 101, 88, 83, 95, 98, 107, 100. Do these data support the assumption of a population mean I.Q. of 100. [15]
7. (a) Define Markov chain, regular and Ergodic and stochastic matrices?
- (b) Explain the process of finding expected duration of the game? [15]
8. Obtain the regression equation of y on x from the following data: [15]

x	65	66	67	67	68	69	70	72
y	67	68	65	68	72	72	69	71

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1. (a) A sample of size 64 and mean 60 was taken from a population whose standard deviation is 10. Construct 98% confidence interval for the mean
- (b) A large group of athletes is found to have a mean weight of 140 lbs with a standard deviation of 5 lbs. One student from a college was found to weigh 120 lbs. Can it be reasonably concluded that he was not an athlete? [7+8]
2. Given $n=10$, $\sigma_x = 4.5$, $\sigma_y = 3.6$ and sum of the product of deviation from the mean of X and Y is 64 find the correlation co-efficient. [15]

3. (a) To compare two kinds of bumper guards, 6 of each kind were mounted on a car and then the car was run into a concrete well. The following are the costs of repair.

Guard 1	107	148	123	165	102	119
Guard 2	134	115	112	151	133	129

Use 0.01 level of significance to test whether the difference between two sample means is significant.

- (b) The blood pressure of 5 women before and after intake of a certain drug are given below.

Before	110	120	125	132	125
After	120	118	125	136	121

Test whether there is significant change in blood pressure at 1% level of significance. [15]

4. (a) A problem in Mechanics is given to three students A, B, and C, whose chances of solving it are $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{1}{4}$ respectively
what is the probability that the problem is solved?
- (b) A fair die is tossed. Let the random variable X denote the twice the number appearing on the die:
 - i. Write the probability distribution of X
 - ii. The mean
 - iii. The variance [7+8]

5. Which of the following matrices are regular [15]

(a) $\begin{bmatrix} 1/3 & 0 \\ 1/3 & 1 \end{bmatrix}$

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

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

6. Bank plans to open a single server drive in banking facility at a certain centre. It is estimated that 20 customers will arrive each hour on average . If on average, it requires 2 minutes to process a customer's transaction, determine.
- (a) The proportion of time that the system will be idle
 - (b) On the average, how long a customer will have to wait before breaching the server.
 - (c) The fraction of customers who will have to wait. [15]
7. Take 30 slips of paper and label 5 each with -4 and 4; four each with -3 and 3; three each with -2 and 2; two each with -1, 1 and 0. If each slip of paper has the same probability of being drawn find the mean and variance of the distribution. [15]
8. (a) A study shows that 16 of 200 Tractor's produced on one assembly line required extensive adjustments before they could be shipped, while the same was true for 14 of 400 tractors produced on another assembly line. At the .01 level of significance, does this support the claim that the second production line does superior work.
- (b) The owner of a machine shop must decide which of two snack vending machines to install in his shop. If each machine is tested 250 times, the first machine fails to work 13 times and the second machine fails to work 7 times test at the .05 level of significance whether the difference between the corresponding sample proportions is significant. [15]
