

II B.Tech II Semester Regular Examinations, Apr/May 2007
PROBABILITY AND STATISTICS
 (Common to Civil Engineering, Mechanical Engineering, Chemical Engineering, Mechatronics, 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) A problem in statistics is given to three students A,B,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.
- (c) Find the probability of getting a sum of 10 if we throw two dice. [5+5+6]
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) 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 number of business the sales of while are likely to range between Rs. 30,000/- and Rs.40,000/- [8+8]
4. If the population is 3,6,9,15,27.
 - (a) List all possible samples of size 3 that can be taken without replacement from the finite population.
 - (b) Calculate the mean of each of the sampling distribution of means.

- (c) Find the standard deviation of sampling distribution of means. [5+5+6]
5. (a) A sample of size 36 was drawn and its mean was found to be 80. Test whether this sample could have come from a normal population with mean 90 and variance 225?
- (b) A die is thrown 1350 times 5 or 6 obtained 650 times test whether the die is unbiased. [8+8]
6. Suppose during 400 five- minute intervals the ari-traffic control of an airport received 0, 1,.....,12 messages and observed frequencies are given in the following table.

No.of Messages

x	0	1	2	3	4	5	6	7	8	9	10	11	12
f	4	15	47	76	68	74	46	39	15	9	5	2	0

Test whether the Poisson distribution with $\lambda = 4.5$ provides a good fit to the above data? [16]

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 $y = ax + b$ Humidity (x)

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

- (b) Find the most plausible values of x and y

$$x + 2y - 7 = 0 \quad 2x + 3y - -2 = 0$$

$$x + 8y - 3 = 0 \quad 3x - y + 5 = 0.$$

[8+8]

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]

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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 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. At least one boy. [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. Take 30 slips of paper and label 5 each -4 and 4, four each - 3 and 3, three each - 2 and 2 and each-1, 0 and 1, if each slip of the paper has the same probability of being drawn find the probabilities of getting - 4,- 3, - 2, - 1, 0, 1, 2, 3, 4 and find the mean and variance of this distribution of means. [16]
5. (a) A sample of size 64 and mean 60 was taken from a population whose standard deviation is 10. Find 95% confidence interval for the mean.
- (b) Experience has shown that 10% of a manufactured product is of top quality. What can you say about the maximum error with 95% confidence for 100 items

(c) A coin is tossed 512 times. Head turned up 244 times. Can you say that the coin is unbiased. [5+5+6]

6. (a) To examine the hypothesis that the husbands are more intelligent than the wives, an investigator took a sample of 10 couples and administered them a test which measures the IQ as follows:

Test the hypothesis with a reasonable test at the level of significance of 0.05?

Husbands:	117	105	97	105	123	109	86	78	103	107
Wives	106	98	87	104	116	95	90	69	108	85

- (b) In an investigation on the machine performance the following results were obtained:

	No.of Units inspected	No. of defectives
Machine 1	375	17
Machine 2	450	22

Test whether there is any significant performance of two machines at $\alpha=0.05$ [8+8]

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

x	0.0	.5	1.0	1.5	2.0	2.5
y	.1	.45	2.15	9.15	40.35	180.75

- (b) Find the most plausible values of x and y from the following equations $x + 2y = 6$, $2x - y = 2$, $2x - 5y = 7$, $3x - 4y = -4$ [8+8]

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) Of the three men, the chances that a politician, a businessman or an academician will be appointed as a vice-chancellor (V.C.) of a university are 0.5, 0.3, 0.2 respectively. Probability that research is promoted by these persons if they are appointed as v.c. are 0.3, 0.7, 0.8 respectively.
 - i. Determine the probability that research is promoted
 - ii. If research is promoted, what is the probability that V.C. is an academician
- (b) There are two boxes in box I, 11 cards are there numbered 1 to 11 and in box II 5 cards numbered 1 to 5. A box is chosen and a card is drawn. If the card shows an even number then another card is drawn from the same box. If card shows an odd number another card is drawn from the other box. Find the probability that
 - i. both are even
 - ii. both are odd
 - iii. if both are even. What is the probability that they are from box 1. [8+8]
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 $\frac{1}{2}$. [8+8]
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 number of business the sales of while are likely to range between Rs. 30,000/- and Rs.40,000/- [8+8]
4. (a) What is the probability that X will be between 75 and 78 if a random sample of size 100 taken from an infinite population has mean 76 and variance 256.
 (b) Write about
- i. Null hypothesis
 ii. Type 1 & type II errors. [8+8]
5. (a) A lady stenographer claims that she can take dictation at the rate of 118 words per minute can we reject her claim on the basis of 100 trials in which she demonstrates a mean of 116 words and a S.D of 15 words.
 (b) In a large consignment of oranges a random sample of 64 oranges revealed that 14 oranges were bad. If it reasonable to ensure that 20% of the oranges are bad? [8+8]
6. The following is the distribution of the daily number power failures reported in a western city on 300 days:
- | | | | | | | | | | | |
|--------------------------|---|----|----|----|----|----|----|----|---|---|
| Number of Power Failures | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Number of Days | 9 | 43 | 64 | 62 | 42 | 36 | 22 | 14 | 6 | 2 |
- Test the good ness of fit of porisson distribution at .05 level. [16]
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 $y = a + b x + cx^2$. [10+6]
8. (a) If there are no ties in the ranks then show that the rank correlation is given by $\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$ 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 $y = 0.399 x + 6.394$ 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) The probabilities that students A,B,C,D solve a problem are $1/3$, $2/5$, $1/5$ and $1/4$ respectively. If all of them try to solve the problem, what is the probability that the problem is solved.
- (b) In a bolt factory machines A,B,C manufacture 20%, 30% and 50% of the total of their output and 6%, 3% and 2% are defective. A bolt is drawn at random and found to be defective. Find the probabilities that it is manufactured from
- i. Machine A
 - ii. Machine B
 - iii. Machine C
- [8+8]

2. (a) If X is a continuous random variable with distribution.

$$f(x) = \begin{cases} \frac{1}{6}x + k & \text{if } 0 \leq x \leq 3 \\ 0 & \text{elsewhere} \end{cases}$$

determine

- i. the value of k
 - ii. the mean
 - iii. $P(1 \leq x \leq 2)$
- (b) Derive the formula to find the mean and variance of Binomial distribution
- [8+8]
3. (a) The probabilities of a poisson variate taking the values 1 and 2 are equal. Find
- i. μ
 - ii. $p(x \geq 1)$
 - iii. $p(1 < x < 4)$
- (b) In a sample of 1000 cases, the mean of a certain test is 14 and standard deviation is 2.5. Assuming the distribution to be normal, find
- i. how many students score between 12 and 15?
 - ii. how many score above 18
 - iii. how many score below 8
- [8+8]

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. [4+4+4+4]
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 478.6 to 495.4 [8+8]
6. Suppose during 400 five- minute intervals the ari-traffic control of an airport received 0, 1,.....,12 messages and observed frequencies are given in the following table.

No.of Messages

x	0	1	2	3	4	5	6	7	8	9	10	11	12
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Test whether the Poisson distribution with $\lambda = 4.5$ provides a good fit to the above data? [16]

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- (b) Find the most plausible values of x and y from the following equations $x + 2y = 6$, $2x - y = 2$, $2x - 5y = 7$, $3x - 4y = -4$ [8+8]
8. (a) Find the coefficient of correlation between x and y for the following data

X	10	12	18	24	23	27
Y	13	18	12	25	30	10

- (b) Show $r = \frac{\sigma_{x+y}^2 - \sigma_x^2 - \sigma_y^2}{2\sigma_x\sigma_y}$ Where r = coefficient of correlation between x and y
 σ_x^2 , σ_y^2 , σ_{x+y}^2 are the variances of x, y and x+y respectively.

[8+8]
