

[This question paper contains 4 printed pages.]

Sr. No. of Question Paper : 529

Your Roll No.....
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Unique Paper Code : 2372571103

Name of the Paper : Descriptive Statistics and Probability Theory

Name of the Course : **B.A. / B.Sc. (P) with Statistics under NEP.**

Semester : I

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question No. 1 is compulsory.
3. Attempt any **five** questions from the remaining questions.
4. **All** questions carry equal marks.
5. Use of simple calculator is allowed.

1. (a) Answer the following :

- (i) Geometric mean of the observations 2, 0 and 8 with frequencies 1, 2 and 3 respectively is _____ .
- (ii) Median = _____ Decile.
- (iii) Two uncorrelated variables are always independent (True/False).
- (iv) The number of elements in the sample space when a die is rolled thrice is _____ .
- (v) The sum of the probabilities of all mutually exclusive and exhaustive events in a sample space is always _____ . (1*5)

(b) Average marks in statistics of 10 students of a class was 68. A new student took admission with 72 marks whereas two existing students left the college. If the marks of these students were 40 and 39, find the average marks of the remaining students.

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- (c) Prove that algebraic sum of deviations of a set of values from their arithmetic mean is zero.
- (d) Differentiate between pairwise independence and mutual independence of events.
- (e) Can $Y = 5 + 1.4X$ and $X = 3 + 0.5Y$ be the estimated regression equations of Y on X and X on Y respectively? Explain your answer with suitable arguments.
- (f) For a frequency distribution x_i/f_i , $i = 1, 2, \dots, n$ prove that $\beta_2 > 1$. (2*5)

2. (a) Show that in finding the arithmetic mean of a set of readings on a thermometer, it does not matter whether we measure temperature in Centigrade or Fahrenheit, but that in finding the geometric mean, it does matter which scale we use.

- (b) The marks (out of 100) obtained by 50 students are summarized below :

Marks :	0-20	20-40	40-60	60-80	80-100
Frequency :	4	10	18	12	6

Find :

- (i) The mean and variance of the distribution using the method of change of origin and scale.
- (ii) The median and mode of the distribution. (7,8)
3. (a) Explain any three measures of dispersion along with their merits and demerits.
- (b) Define moments. For a distribution, the mean is 10, variance is 16, $\gamma_1 = +1$ and $\beta_2 = 4$. Obtain the first four moments about the origin. Comment upon the nature of the distribution.

- (c) Explain any two approaches to defining probability. Also discuss their merits and demerits. (6,5,4)
4. (a) For any three events A, B and C, show that $P(A \cup B \cup C) \leq P(A) + P(B) + P(C)$. If three machines A, B and C in a factory can fail on a given day with corresponding probabilities of failure being $P(A) = 0.2$, $P(B) = 0.3$ and $P(C) = 0.1$, then find the upper bound for the probability that at least one machine fails on that day.
- (b) A factory has three machines, A, B, and C, producing 25%, 35%, and 40% of the total products, respectively. The percentages of defective items produced by them are 5%, 4%, and 2%. If a product is found to be defective, determine the probability that it was produced by machine A.
- (c) From a city population, the probability of selecting (i) a male or a smoker is $7/10$, (ii) a male smoker is $2/5$ and, (iii) a male, if a smoker is already selected is $2/3$. Find the probability of selecting (a) non-smoker (b) a male and (c) a smoker, if a male is first selected. (6,4,5)
5. (a) Define Spearman's rank correlation coefficient. Prove that Spearman's rank correlation coefficient (ρ) for non-repeated ranks is given by :
- $$\rho = 1 - \frac{6 \sum_{i=1}^n d_i^2}{n(n^2 - 1)}, \text{ where } d_i \text{ denotes the difference between the ranks of } i^{\text{th}} \text{ individual.}$$
- (b) Define regression coefficients. Prove that the modulus value of the arithmetic mean of the regression coefficients is not less than the modulus value of the correlation coefficient r .
- (c) Prove that two independent variables are uncorrelated but the converse may not always be true. (7,4,4)

6. (a) Define Karl Pearson's coefficient of correlation between two random variables X and Y . What is the effect of change of origin and scale on correlation coefficient?
- (b) Let $x_1, x_2, \dots, x_n$ be the ranks of n individuals according to a character A and $y_1, y_2, \dots, y_n$ be the corresponding ranks of the same individuals according to other character. Further it is given that $x_i + y_i = 1 + n$. for $i = 1, 2, \dots, n$. Compute the value of rank correlation coefficient between the characters A and B .
- (c) Calculate quartiles from the following data. Hence, calculate inter quartile range and Bowley's coefficient for the given data.

Value	0 - 4	5 - 9	10 - 14	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39
Frequency	5	8	10	12	7	6	3	2

(5,5,5)