1128

B.A./B.Sc. (General), First Semester

Statistics

Paper - 101: Probability Theory and Descriptive Statistics – I

Time allowed: 3 Hours

Max. Marks: 65

NOTE: Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Unit.

x-x-x

1. (i) Define a sample space and give two examples.

   (ii) Show that for $A \subseteq B$ we have $P(A) \leq P(B)$.

   (iii) Let the three independent events A, B and C be such that $P(A) = P(B) = P(C) = \frac{2}{3}$. Find $P[(A^c \cap B^c) \cup C]$.

   (iv) List two possible limitations of secondary data.

   (v) List the essential components of a statistical table.

   (vi) Write down the properties of cumulative distribution function.

   (vii) Differentiate between qualitative and quantitative variables.

   (2, 2, 2, 1, 2, 2, 2)

UNIT I

2. (a) Give an axiomatic definition of probability.

   (b) If A and B are two events, then show that
   $$P(A \cap B) \leq P(A) \leq P(A \cup B) \leq P(A) + P(B).$$

   (c) Three technicians have a record of 60%, 70% and 50% respectively of destroying a tissue from their laser-guns. What is the probability that on a given day, when all the three set to destroy the tissue, only one of the three is able to achieve the success?

   (2, 5, 6)

3. (a) Define a partition of the sample space and obtain the multiplication theorem on probability.

   (b) In a Lab, three researchers, namely X, Y and Z have expertise in performing an experiment. The chances of their being available for the experiment on a given day are 30%, 40% and 30% respectively and their being successful with the experiment are 1/3, 1/2 and 1/4 respectively. One fine day it was announced that the Lab has successfully completed the experiment. Who of the three researchers is most likely to have done so?

   (6, 7)

4. (a) Define variance of a random variable. State its important properties.

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(b) Let the pdf of a random variable X be $f(x) = 3x^2$, $0 \le x \le 1$, and 0, otherwise. Find $E(X)$, $E(3X-2)$ and $V(X)$.

(c) Let $f(x) = \frac{1}{3}$, $-1 \le x \le 2$, and 0, otherwise, be the pdf of random variable X, find the distribution function and the pdf of $Y = X^2$. (3, 6, 4)

5. (a) Suppose that the joint pdf of a two dimensional random variable (X,Y) is given by

$$f(x, y) = \frac{1}{8} (6-x-y), \qquad 0 < x < 2, \qquad 2 < y < 4$$

Compute (i) $P(X < 1 \mid Y < 3)$ and (ii) $E(X|Y = y)$.

(b) Define the moment generating function (mgf) of a random variable X. If $Y = \frac{X-a}{b}$, where a and b are constants, express the moment generating function of Y in terms of X. (8, 5)

UNIT II

6. (a) What is a diagram? Give an account of the different diagrammatic representation of statistical data.
(b) To represent the information on expenditures on six 'headings' in two companies, which diagrams/graphs could be used and which one could be the most appropriate and discuss why? (8, 5)

7. (a) What do you understand by the term 'Central tendency'? List various measures of Central tendency and compare any two of them.
(b) For the following table calculate the arithmetic mean, median and mode and comment about skewness.

X:	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50
f:	5	8	15	12	7

(6, 7)

8. What is dispersion? List the characteristics of a good measure of dispersion. Show that (i) Standard deviation is independent of change of origin. (ii) Mean deviation is least when measured from the median. (2, 3, 4, 4)

9. With suitable examples, write short notes on:
(a) Designing of a Questionnaire.
(b) Skewness and Kurtosis.
(c) Box and Whisker plot. (5, 5, 3)