2025

STATISTICS — MINOR

Paper : MN-1

(Descriptive Statistics-I and Probability-I)

Full Marks : 75

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

1. Answer ***any five*** of the following : 2×5

(a) Name two different diagrams used in representing an attribute.

(b) Distinguish between primary data and secondary data.

(c) In case of a frequency distribution with open-end class interval, mention the name of a measure of central tendency and of a measure of dispersion.

(d) Prove or disprove : $\sum_{i=1}^{50}|i-25.1| = \sum_{i=1}^{50}|i-25.2|$ by suitable statistical argument.

(e) Find the standard deviation of two real numbers 'a' and 'b'.

(f) If two events are independent, are they mutually exclusive too?

(g) For any two events A and B, $P(A) = 0.5$ and $P(A \cap B) = 0.2$. Find the value of $P(A^C \cup B)$.

(h) If $P(A) = 1/4$, $P(B) = 2/5$, $P(A \cup B) = 1/2$, find $P(A \mid B)$.

2. Answer ***any four*** of the following : 5×4

(a) Give the classical definition of probability. What are its limitations?

(b) If $P(A) = p$ and $P(B/A) = P(B^c/A^c) = 1-p$, find $P(A/B)$.

(c) In a sample space with four equally likely sample points, define three events A, B and C such that they are pair wise independent but not mutually independent.

(d) What is the probability that four S's come consecutively in the word 'MISSISSIPPI'?

(e) Define Histogram and describe how it is constructed. Mention one use of it.

(f) Give two examples where median and mode are the appropriate measures of central tendency but not the arithmetic mean.

(g) Show that the central moments are invariant under the change of origin, but not under the change of scale. Also show that an odd order central moment will vanish for a symmetric distribution.

(h) Find the standard deviation of first n natural numbers.

3. Answer ***any three*** of the following :

(a) (i) Define conditional probability. For three events A, B and C, such that $P(A \cap B) > 0$, show that $P(A \cap B \cap C) = P(A)\,P(B \mid A)\,P(C \mid A \cap B)$.

(ii) Three identical boxes A, B and C contain respectively 2 white, 4 black balls; 4 white, 2 black balls and 3 white, 3 black balls. One ball is drawn at random from a randomly chosen box. If the ball is white, find the probability that it is drawn from box C. (2+5)+8

(b) (i) For three events A, B and C, find a formula for calculating $P(A \cup B \cup C)$.

(ii) The nine digits 1, 2, ..., 9 are arranged in random order to form a nine-digit number. Find the probability that 2, 3 and 4 appear as neighbors if, the order is not maintained.

(iii) Describe the sample space when a coin is tossed thrice. In context of this experiment, define two events which are mutually exclusive but not exhaustive and two events which are not mutually exclusive but exhaustive. 5+5+5

(c) (i) A candidate is interviewed for three posts. For the first post there are 3 candidates, for the second there are 4 and for the third there are 2. What is the probability of his getting at least one post?

(ii) Three persons A, B and C turn in tossing a fair coin. He who gets the first head wins the game. Find the probability of A to win.

(iii) State and prove Bayes' theorem in probability theory. 4+4+7

(d) (i) Prove that, for 'n' positive values $x_1, x_2, \ldots x_n$, A.M. $\geq$ G.M. In particular if $x_i = r^{i-1}$, $r > 1$, $i = 1, 2, \ldots, n$ then find the values of A.M. and G.M.

(ii) Let, there be two non-overlapping groups of 'n_1' and 'n_2' values with means $\overline{x_1}, \overline{x_2}$ and variances s_1^2, s_2^2 respectively. Then, show that, the combined variance s^2 of $(n_1 + n_2)$ values can be expressed as

$$s^2 = \frac{n_1 s_1^2 + n_2 s_2^2}{n_1 + n_2} + \frac{n_1 n_2}{(n_1 + n_2)^2}\left(\overline{x_1} - \overline{x_2}\right)^2$$

(5+4)+6

(e) (i) For a set of n observation show that $S^2 \leq R^2/4$, where R and S denote respectively the range and standard deviation of the observations.

(ii) Discuss the merits and demerits of the standard deviation as a measure of dispersion.

(iii) Prove that the absolute difference between arithmetic mean and median cannot be greater than the standard deviation. 6+4+5

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