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**MST-003**

**POST GRADUATE DIPLOMA IN  
APPLIED STATISTICS (PGDAST)**

**Term-End Examination**

**June, 2024**

**MST-003 : PROBABILITY THEORY**

*Time : 3 Hours*

*Maximum Marks : 50*

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**Note :** (i) *Question No. 1 is compulsory.*

(ii) *Attempt any **four** questions from the remaining question no. 2 to 7.*

(iii) *Use of scientific (non-programmable) calculator is allowed.*

(iv) *Use of formulae and statistical tables booklet for PGDAST is allowed.*

(v) *Symbols have their usual meanings.*

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**P. T. O.**

1. State whether the following statements are True or False. Give reasons in support of your answers : 2 each

(a) If  $X \sim N(10, 2)$  and  $Z = \frac{X-10}{\sqrt{2}}$ , then

$$Z \sim N(0, \sqrt{2}).$$

- (b) If the probability density function of a variable  $X$  is  $f(x) = Cx(2-x)$ ,  $0 \leq x \leq 2$ , then the value of  $C$  will be  $3/4$ .

- (c) If three unbiased coins are tossed simultaneously, then the probability of getting at least two heads is  $3/8$ .

- (d) Past experience of 200 consecutive days speaks that weather forecast of a station is 120 times correct. If a day of the year is selected at random, then the probability that the weather forecast on this day is false will be  $\frac{200}{365}$ .

- (e) Three athletes  $A_1$ ,  $A_2$  and  $A_3$  are participating in the Olympics. If  $A_1$  is twice as likely to win as  $A_2$  and  $A_2$  is twice as likely to win as  $A_3$ , then the probability of winning  $A_1$  is  $4/7$ .

2. (a) A marketing research firm wants to collect information about households with

computers and internet access in a city. After conducting an intensive survey, it was revealed that 60% of the household have computers, 70% of the households have internet connection. Suppose 50% of the households have computer with internet connection. A household is randomly selected then what is the probability that :

- (i) the household has computer or internet access ?
  - (ii) the household has computer with internet access but not both ?
  - (iii) the household has neither computer nor internet access. 5
- (b) In an office, three clerks are assigned to process incoming mails. The first clerk processes 40%, the second clerk processes 35% and the third 25% of the mail. The first second and third has an error rate 4%, 6% and 3% respectively. A mail is selected at random from a days output and is found to have an error. The manager of the office wishes to know the probability that the

mail was processed by first clerk. Find the desired probability. 5

3. (a) If a random variable  $X$  takes the values 1, 2, 3 and 4 such that : 4

$2P(X = 1) = 3P(X = 2) = P(X = 3) = 5P(X = 4)$  then find :

- (i) probability distribution of  $X$
  - (ii) cumulative distribution functions of  $X$ .
- (b) The lifetime of a certain kind of battery has a mean life of 400 hours and standard deviation as 45 hours. Assuming that the distribution of lifetime to be normal, find
- (i) the percentage of batteries with a lifetime of at least 470 hours.
  - (ii) the proportion of batteries with a lifetime between 385 and 415 hours.
  - (iii) the minimum life of the best 5% of batteries. 6

4. (a) Three balls are drawn at random without replacement from a box containing 2 white, 3 red and 4 black balls. If  $X$  denotes the number of white balls drawn and  $Y$  denotes the number of red balls drawn, find the joint probability distribution of  $(X, Y)$ . 6

- (b) The retail price of a 5 kg bag of white cement of a company uniformly varies from ₹ 200 to ₹ 230 per bag. Compute mean and standard deviation of the prices of the distribution. Also compute the probability of a randomly selected price is less than 227. 4
5. (a) If the probability that an applicant of a driving license will pass the road test on any given trial is 0.8, the what is the probability that he will finally pass the test : 5
- (i) in the fourth trial ?
- (ii) before the 4th trial ?
- (b) A manufacturer of screws knows that 4% of his product is defective. If he sells the screw in boxes of 100 screws and guarantees that not more than 5 screws will be defectives. What is the probability that a box will fail to meet the guaranteed quality ? 5
6. (a) A stall in a college fest allows a person to buy a ticket and throw two dice. If this gives a double six, 10 times the ticket money is refunded, if one six trans up, double the ticket money is refunded and in other cases nothing is refunded will it be profitable to run such a stall ? What is the expected profit/loss of the person ? 5

- (b) Sixty percent of the employees of a XYZ corporation are college graduate. Of these ten percent are in sales. Of the employees who did not graduate from college, eighty percent are in sales. What is the probability that an employee selected at random is : 5
- (i) in sales ?
  - (ii) neither in sales nor a college graduate.
7. (a) A taxi cab company has 12 Maruti Cars and 8 Honda Cars. If 5 of these taxi cabs are in the workshop for repairing and the chance of a Maruti Car in for repairing is likely to as a Honda Car, then what is probability that :
- (i) 3 of these are Maruti Cars and 2 are Honda Cars ?
  - (ii) At least 3 of these are Maruti Cars. 5
- (b) The time (in hours) required to repair a machine is exponentially distributed with mean time 2 hours. What is the probability that the repair time :
- (i) exceeds 2 hours
  - (ii) lies between 1 hour to 3 hours. 5