SYLHET CADET COLLEGE

FIRST TERM-END EXAMINATION - 2024 | Set | A |
CLASS: XII
STATISTICS (CREATIVE) **Subject Code:** | 1 | 3 | 0 |
SECOND PAPER
TIME – 2 hours & 35 minutes
FULL MARKS – 50

[**N.B.** – The figures of the right margin indicate full marks. Read the stems carefully and answer the associated questions. Answer any **FIVE** questions taking at least two questions from each group]

Group - A

1. **A jar contains 5 red marbles and 7 yellow marbles. Three marbles are drawn at random.**

   (a) What is a simple event? 1

   (b) In how many different ways can 5 books be arranged on a shelf? 2

   (c) What is the probability that all marbles are yellow? 3

   (d) What is the probability that a marble has a different color? 4

2. $P(M|N) = \frac{2}{9}, P(M \cup N) = \frac{5}{7}, P(N) = \frac{4}{7}$

   (a) What is a certain event? 1

   (b) Briefly explain empirical probability with an example. 2

   (c) Calculate $P(M \cap \bar{N})$. 3

   (d) Examine whether 4

   i. $P(M|N) = P(N|M)$
   ii. $P(M \cap \bar{N}) = P(\bar{M} \cap N)$

3. **The joint probability function of two random variables X and Y is described by:**

$$P(X, Y) = \frac{2x + y + 1}{52}; \quad x = 1, 2; \quad y = 1, 2, 3, 4$$

   (a) Give an example of a continuous random variable 1

   (b) What are the required properties of a probability distribution? 2

   (c) Find the marginal distribution $P(X)$. 3

   (d) Compute $P(Y|X)$ for $X = 2$. 4

4. **The probability distributions of daily sales of two popular coffee brands, Brand A (X) and Brand B (Y), are:**

Sales (cups)	50	100	150	200	250
P(X)	0.05	0.3	p	0.25	0.1
P(Y)	0.1	0.35	0.3	0.2	0.05

   (a) How can you expand $E(x + y)$? 1

   (b) Determine the formula of variance in terms of expectation. 2

   (c) Find p from the table. 3

   (d) Which brand has a more consistent daily sales distribution? Justify your answer. 4

Group - B

5. **A company produces smartphones, and it is known that 5% of the smartphones have a manufacturing defect on average. The company ships 15 smartphones in each box, and a retailer purchases 500 boxes.**

   (a) How many parameters does the Binomial distribution have? 1

   (b) Can $V(X)$ be equal to $E(X)$ in binomial distribution? Examine. 2

   (c) What is the probability that the number of defective smartphones in a box is at least 1? 3

   (d) How many boxes are expected to contain exactly 2 defective smartphones? 4

6. **A random variable is distributed as follows:**

Value	0	1	2	3	4	5
Frequency	60	80	50	20	6	2

   (a) What is the mean of a Poisson distribution with parameter λ? 1

   (b) If a Poisson distribution is $P(x) = \frac{e^{-m} m^x}{x!}, P(x + 1) =?$ Derive in terms of $P(x)$. 2

   (c) Find the mean and standard deviation of the given distribution. 3

   (d) Compare the observed and expected frequencies, assuming a Poisson. 4

7. **The number of cars passing through a toll booth follows a Poisson distribution with a mean of 5 cars per minute.**

   (a) What is a Poisson process? 1

   (b) Prove $\sum_{i=1}^{\infty} P(x) = \sum_{i=1}^{\infty} \frac{e^{-m} m^x}{x!} = 1$ 2

   (c) Determine the probability that exactly 3 cars pass through the toll booth in a minute. 3

   (d) If $P(X = a) = P(X = b)$, find the value of a and b. What pattern do you observe? 4

8. **Population of New York, Los Angeles, and Chicago by different age groups and areas are given below:**

City	Age			Area (sq. km)
	0-14	15-64	65+	
New York	1,200,000	5,000,000	700,000	789
Los Angeles	1,000,000	4,500,000	500,000	1,302
Chicago	900,000	3,800,000	600,000	606

   (a) What is the formula of crude birth rate? 1

   (b) Two dependency ratios are $d_1 = 98\%$ and $d_2 = 104\%$. In which case are there more dependent people per 1000 individuals?

   (c) Find and compare the dependency ratios of New York and Chicago. 3

   (d) Based on the data, which city is more comfortable for living? Justify your choice. 4