# Statistics Question Bank

Second Paper

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# Contents

# Chapter 1

# Probability

## 1.1 Creative Questions

1. **It is observed that in a college, there are 100 students, of whom 30 play football, 40 play cricket, and 20 play both.**

   (a) What is the range of probability? 1

   (b) What is the relationship between independence and mutual excluvity? 2

   (c) Are the probabilities of playing cricket and that of football independent? Prove. 3

   (d) If a student is selected randomly, and if he does not play cricket, what is the probability that he plays football? 4

2. **A box contains four blue and 6 green balls. 3 balls are drawn randomly.**

   (a) What is the value of ${}^{n}C_{r}$? 1

   (b) Illustrate the difference between permutation and combination with an example. 2

   (c) What is the probability that all balls are green? 3

   (d) What is the probabilith that one ball has a different color? 4

3. **Sadman has an urn with 5 red and 4 white balls. He has randomly drawn two balls from the urn.**

   (a) What is the probability of an uncertain event? 1

   (b) Write the third axiom of probability. 2

   (c) What is the probability that both the balls drawn by Sadman are white? 3

   (d) Are the probabilities of both balls being same color and different color equal? Analyze. 4

4. **Two dice are thrown together. The dice are named A and B.**

   (a) What is P(A=7)? 1

   (b) Create the sample space. 2

   (c) What is the probability that the outcomes of A & B are different? 3

   (d) Determine the probability that the summation of outcome of two dice is a prime number. 4

5. **A magician draws two cards from a pack (i) with replacement and then (ii) without replacement. The cards were well-shuffled before drawing.**

   (a) What is the probability of an impossible event? 1

   (b) How to determine the probability of a joint event? 2

   (c) As per (i), what is the probability that the cards have different color? 3

   (d) As per (ii), what is the probability that the cardsare aces of same color? 4

6. $P(A) = \frac{3}{10}, P(B) = \frac{2}{5}, P(B \cup A) = \frac{1}{2}$
   (a) What is an independent event? 1
   (b) What is the relationship between independency and mutual excluvity? 2
   (c) Find $P(A|B)$ and $P(B|A)$ 3
   (d) Verify the equality mathematically & empirically: $P(B) = P(A) \cdot P(B|A) + P(\bar{A}) \cdot P(B|\bar{A})$ 4
7. $P(A|B) = \frac{1}{8}, P(A) = \frac{1}{2}, P(B) = \frac{1}{5}$
   (a) Write down the range of probability. 1
   (b) Find $P(A \cap B)$. 2
   (c) Find $P(A|\bar{B})$. 3
   (d) Are the probabilities $P(A|B)$ and $P(B|A)$ equal? Justify 4
8. **Sakib has recently graduated from the University of Dhaka. he applies to two firms - EduCube & Digic- for a Data Analyst job. The probability of hiring by EduCube is 0.8 and by Digic is 0.4. The probability that none hires is 0.5.**
   (a) What is a sample space? 1
   (b) Explain how to find $P(\bar{A} \cap B)$ using Venn Diagram. 2
   (c) Find the probability of hiirng by by Digic but not by EduCube. 3
   (d) Find the probability that no firm will reject him. 4
9. **Recently there is an increase in the number of electronic medias in Bangladesh. A professor stated in the class room that very few people now resort to print media for news. A research indicates 70% people collect news from electronic media, 60% from print media, and 50% from both.**
   (a) What is an impossible event? 1
   (b) Write the event "None of the two occurs" in two different notations. 2
   (c) What is the probability of getting news from at most one type of media? 3
   (d) Is the professor correct in his/her statement? Analyze. 4
10. **A coin is tossed five times. The number of heads appearing from the tosses is considered a discrete random random variable.**
    (a) What is a discrete random variable? 1
    (b) Are probability distributions and frequency distributions similar? Show with an example. 2
    (c) Find the probability distribution from the stem and show in a table. 3
    (d) Find the probability that a head will appear in more than 3 tosses. 4
11. **A red and a blue dice are thrown once. The dice are absolutely neutral and independent.**
    (a) What is a simple event? 1
    (b) Give an example of a certain event using set theory. 2
    (c) Find the probability that the difference of two digits from two dices is less than 3. 3
    (d) Are the probabilities of getting greater digit from the blue die and that from the red die equal? Justify. 4

## 1.2 Short Questions

1. Question 1
2. Question 2
3. Question 3
4. Question 4

# Chapter 2

# Random Variable and Probability Function

## 2.1 Creative Questions

1. **The joint probability function of two random variables X and Y is given below:**

   $P(X,Y) = \frac{x+2y}{16}; x = 0,1; y = 0,1,2,3$

   (a) Write down the formula of conditional proibability. 1

   (b) What is the relationship between marginal and joint probability? 2

   (c) Find P(X). 3

   (d) Find $P(X|Y)$ and $P(X|0)$. 4

2. **The probability distributions of a random variable X are given below:**

Table 2.1: **Distribution - A**

| x | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| P(x) | 0.20 | 0.10 | 0.08 | w | 0.02 | 0.10 | 0.30 |

Table 2.2: **Distribution - B**

| x | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| P(x) | 0.20 | 0.10 | 0.30 | 0.50 | 0.20 |

   (a) What is a probability mass function? 1

   (b) Can we dtermine the probability of a certain value of a discrete random variable? 2

   (c) What is the value of w? 3

   (d) Which table is a proper probability distribution? Justify with mathematical reasoning. 4

3. **A fair coin is tossed five times. Number of heads appearing are noted, considering it a discrete random variable.**

   (a) Give a real life example of a discrete random variable. 1

   (b) Can discrete variable have infinite number of possible outcomes? 2

   (c) Find the probability distribution from the stem. 3

   (d) Construct thedistribution function and hence find $F(X \leq 3)$. 4

4. **The probability density function of a continuous random variable is**

$$f(x) = \begin{cases} k(x+1), & 0 \le x \le 1 \\ 0, & otherwise \end{cases}$$

   (a) What is a random variable? 1
   (b) Find the value of k 2
   (c) Find the probability that the values of x would lie between 0 and 0.5. 3
   (d) What is the probability that X is greater than 0.8? 4

5. **The probability distribution of a discrete random variable X is given below:**

| x | -2 | -1 | 0 | 1 | 3 | 4 |
|---|---|---|---|---|---|---|
| P(x) | 0.1 | k | 2k | 3k | 4k | 0.2 |

   (a) What is $\Sigma P(x)$? 1
   (b) Find the value of k. 2
   (c) Find $P(X \ge 0)\&P(X < 1)$ 3
   (d) Find the cumulative distribution function, F(X) and F(2) and explain. 4

6. **The joint probability function of two random variables X & Y is given below:**
   $P(x, y) = \frac{1}{21}(x + y); x = 1, 2, 3 \ \& \ y = 1, 2$

   (a) What is a probability density function (pdf)? 1
   (b) What is P(X=a) in a pdf, where a is an aribitrary number? 2
   (c) Find the marginal probabilities. 3
   (d) Find $P(x|y), P(x|1)$ and $P(y|4)$ 4

7. **The probability density function of a continuous random variable is**

$$f(x) = \begin{cases} kx^2 + kx + \frac{1}{8}, & 0 \le x \le 2 \\ 0, & otherwise \end{cases}$$

   (a) What is a continuous random variable? 1
   (b) Find the value of k 2
   (c) Find the probability that the values of x would lie between1 and 3. 3
   (d) Find the 40th percentile of the distribution and explain. 4

8. **A professor showed a probability distribution in a class:**

| x | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| p(x) | 0.1 | a | 0.3 | b | 0.2 |

**The value of the arithmetic mean of the distribution is 3.**

   (a) What is the formula of expectation? 1
   (b) What is the variance of a constant? Explain logically. 2
   (c) What are the values of a & b? 3
   (d) Find and explain the variance of the distribution. 4

## 2.2 Short Questions

1. What is a continuous random variable? 1
2. Question 1
3. Question 1
4. Question 1

# Chapter 3

# Mathematical Expectation

## 3.1 Creative Questions

1. **X is a random variable having the below functional form:**

   $P(X) = \frac{6-|7-x|}{k}; x = 1, 2, \cdots, 10$
   Y is another variable having the relationship y = 3x+5

   (a) What is joint probability? 1

   (b) What is the minimum possible value of variance? Why? 2

   (c) Find the value of k. 3

   (d) Find E(X) and E(Y). Why are they different? 4

2. **Various sales and their probabilities of a grocery store is given below**

| Sales | 200 | 250 | 275 | 310 | 350 |
|---|---|---|---|---|---|
| Probability | 0.10 | 0.20 | 0.40 | 0.25 | 0.05 |

   (a) Can the expectation of a random variable be negative? 1

   (b) Find the expected sales of the store on a given day. 2

   (c) Compute the dispersion of sales f the store. 3

   (d) To make the expected sale 280, what sale does the store need in place of 200? 4

3. **A survey of Television (TV) users at Gulshan in Dhaka was conducted to find how many sets each family use. The following data were obtained:**

| No of TV set | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| No of family | 10 | 75 | 10 | 5 |

   (a) What is Expectation equivalent to? 1

   (b) Can Variance be negative? Why or why not? 2

   (c) Find the variance of the number of TV sets. 3

   (d) Find and compoare between arithmetic mean and expectation. 4

## 3.2 Short Questions

# Chapter 4

# Binomial Distribution

## 4.1 Creative Questions

1. **A farmer plans to store rice seeds for future use. It was found that 8 out of 20 seeds are rotten. He then collected a sample of 15 seeds.**

   (a) What is Bernoulli trial? 1

   (b) How are Bernoulli and Binomial distributions related? 2

   (c) What is the probability that at least one seed is rotten out of 15? 3

   (d) What is the probability that the number of rotten seeds is greater than the arithmetic mean? 4

## 4.2 Short Questions

# Chapter 5

# Poisson Distribution

## 5.1 Creative Questions

1. **In winter, the probability that it rains on a particular day is 0.015. An analyst observes 100 winter days.**

   (a) What is an experiment? 1

   (b) When can the Poisson distribution be approximated by the Binomial distribution? 2

   (c) Find, using Binomial distribution, the probability that it would not rain at all on the observed days. 3

   (d) Find the probability in 3(c) using Poisson distribution. 4

2. **BTCL receives 2.5 telephone calls on average from 4 pm to 6 pm. The number of calls received is a random variable.**

   (a) When is Poisson variate applicable? 1

   (b) Show conversion criteria and method from Binomial to Poisson distribution. 2

   (c) Find the probability of receiving no more than 3 calls. 3

   (d) Find the pattern of calls and show on graph paper. 4
   Hint: Find probabilities: P(0), P(1), $\cdots$

## 5.2 Short Questions

# Chapter 6

# Normal Distribution

## 6.1 Creative Questions

## 6.2 Short Questions

# Chapter 7

# Index Number

## 7.1 Creative Questions

## 7.2 Short Questions

# Chapter 8

# Sampling

## 8.1 Creative Questions

## 8.2 Short Questions

# Chapter 9

# Vital Statistics

## 9.1 Creative Questions

1. **For projection of population in a future time period, demographers use simple, geometric or exponential growth technique. Each method has its advantages and disadvantages.**

   (a) What is geometric growth? 1

   (b) In geometric growth method, obtain the formula for time required for the population to get doubled [denote rate as r]. 2

   (c) In exponential method, how much unit of time is required for the population to get tripled? 3

   (d) For projecting (predicting future values), is geometric growth method better than the exponential method? Justify. 4

2. **Population of Dhaka and Sylhet by different age groups and areas are given below:**

| Division | Age | | | Area ($km^2$) |
|---|---|---|---|---|
| | 0-14 | 15-64 | 65+ | |
| Dhaka | 10,000,00 | 5,00,000 | 5,80,000 | 1,880 |
| Sylhet | 7,00,000 | 2,70,000 | 4,70,000 | 2,319 |

   (a) Write down the formula of dependency ratio. 1

   (b) What is meant by NRR = 0.983? 2

   (c) Find and compare between the dependency ratios of the cities. 3

   (d) Based on data, which city is more comfortable for living? 4

## 9.2 Short Questions

# Conclusion

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