

# Statistics Question Bank

Second Paper

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# Chapter 1

## Probability

### 1.1 Creative Questions

1. **A coin is tossed five times. The number of heads appearing from the tosses is considered a discrete 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
2. **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
3. **An unbiased coin is tossed 10 times.**
  - (a) If a coin is flung 3 times, how many outcomes are generated? 1
  - (b) If a coin is flung  $n$  times, show how many outcomes are generated. 2
  - (c) What is the probability of getting a) at least 3 heads, b) at most 3 heads? 3
  - (d) Are these probabilities equal? a) Getting at least 2 heads & b) Getting at least 2 tails. Also justify logically. 4
4. **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 exclusivity? 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
5. **A box contains four blue and 6 green balls. 3 balls are drawn randomly.**
  - (a) What is the value of  ${}^nC_r$ ? 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 probability that one ball has a different color? 4
6. **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
7. **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
8. **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 cards are aces of same color? 4
9.  $P(A) = \frac{3}{10}, P(B) = \frac{2}{5}, P(B \cup A) = \frac{1}{2}$
- (a) What is an independent event? 1
- (b) What is the relationship between independency and mutual exclusivity? 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
10.  $P(A|B) = \frac{1}{8}, P(A) = \frac{1}{2}, P(B) = \frac{1}{5}$
- (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
11. **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 hiring by Digic but not by EduCube. 3
- (d) Find the probability that no firm will reject him. 4
12. **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

**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 probability. 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 in dtwo different cases 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 the distribution function and hence find  $F(X \leq 3)$ .

4

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

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

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

1  
2  
3  
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  $\sum P(x)$ ?  
 (b) Find the value of k.  
 (c) Find  $P(X \geq 0)$  &  $P(X < 1)$   
 (d) Find the cumulative distribution function, F(X) and F(2) and explain.

1  
2  
3  
4

6. The joint probability function of two random variables X & Y is given below:

$$P(x, y) = \frac{1}{21}(x+y); x = 1, 2, 3 \text{ \& } y = 1, 2$$

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

1  
2  
3  
4

7. The probability density function of a continuous random variable X is given as:

$$f(x) = \frac{1}{b-a}; a \leq x \leq b$$

- (a) In this distribution, what is  $P(a)$ ?  
 (b) What is the shape of the distribution?  
 (c) Find  $P(a \leq x \leq b)$ .  
 (d) Find and explain the median of the distribution.

1  
2  
3  
4

8. The probability density function of a continuous random variable is

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

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

1  
2  
3  
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.  $P(X) = \frac{3-|4-x|}{k}; x = 2, 3, 4, 5, 6$ 
  - (a) What is the Expectation equivalent to? 1
  - (b) Find the value of k. 2
  - (c) Determine the value of the expectation. 3
  - (d) Find  $V(2X - 1)$  4
2. **The probability distributions of demand of mobile phones of two operating systems (OS) Android (X) and iPhone (Y) are:**

Demand	100	200	300	400	500
P(X)	0.1	0.4	m	0.15	0.1
P(X)	0.09	0.45	0.32	0.11	0.03

- (a) What is Expectation? 1
  - (b) Can Expectation be negative? 2
  - (c) Find m from the table. 3
  - (d) Which OS has higher demand? Analyze. 4
3. **An umbrella seller earns a revenue of BDT. 5000 if it rains. If it does not rain, he loses BDT. 1000. The probability that it rains on a given day is 0.04.**
  - (a) Write down the formula of Expectation for a continuous random variable. 1
  - (b) Can the value of Expectation be zero? 2
  - (c) What is the umbrella seller's expected revenue? 3
  - (d) What should be the minimum probability of raining for him to achieve revenue? 4
4. **A box contains 5 red and 6 white balls. 3 balls are drawn at random. X is the number of white balls drawn.**
  - (a) What does variance measure? 1
  - (b) Can the variance be smaller than standard deviation? 2
  - (c) Find the  $E(X)$  from the stem. 3
  - (d) Find the variance from the stem assuming X is the number of red balls drawn. 4
5. **A professor showed a probability distribution in a class:**
  - (a) What is the formula of expectation? 1

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.

- (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

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

$$P(X) = \frac{6-|7-x|}{k}; x = 1, 2, \dots, 10$$

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

7. **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

8. **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

2. **The number of defective pen produced by a company follows a binomial distribution with expectation 1.5 and variance 1.125..**

- (a) What is the mean of binomial distribution 1
- (b) Can variance be greater than mean in binomial distribution? 2
- (c) Determine the probability function of the number of defective items produced by the company. 3
- (d) What is the probability that the number of defective items is no less than 3? 4

### 4.2 Short Questions

## Chapter 5

# Poisson Distribution

### 5.1 Creative Questions

1. **A can manufacturer observes that 0.1% of the produced cans are faulty. The cans are packaged in carton boxes, with 500 cans in each box. A wholeseller purchases 100 boxes from the manufacturer.**
  - (a) What is shape of Poisson distribution? 1
  - (b) For a Poisson distribution,  $P(2) = P(3)$ . What is  $P(2)$ ? 2
  - (c) Find the probability of exactly one defective can. 3
  - (d) Find the expected number of boxes with no defective cans. 4
2. **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
3. **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:  $P(0)$ ,  $P(1)$ ,  $\dots$
4. **The number of customers coming at a shop per minute follows a Poisson distribution, whose mean is 3.**
  - (a) What is a Poisson variate? 1
  - (b) Can the mean of Poisson distribution be negative? 2
  - (c) Find the probability that the number of customers coming is between 1 and 2. 3
  - (d) Are the probabilities of coming to 2 and 3 customers equal? 4

### 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. A reseracher uses the following data to know about some demographic characterisics.

- (a) What is General Fertility Rate? 1
- (b) What is the difference between GRR and NRR? 2
- (c) Compute the population density. 3
- (d) Are TFR and GRR same for this data? 4

2. 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

3. 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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