

Chapter: Probability Distributions (Random Variables)

General Instructions

1. Total Questions: **20**
2. Duration: **60 Minutes**
3. All questions are compulsory.
4. Read each question carefully before answering.
5. Choose the most appropriate answer from the given options.
6. Use of calculator or electronic devices is strictly prohibited.


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1. A random variable X has the probability distribution: $P(X = x) = kx^2$ for $x = 1, 2, 3$ and $P(X = x) = kx$ for $x = 4, 5$. Find the value of k .
2. Let X be a random variable representing the number of tosses of a fair coin required to get the first head. Find $P(X \geq 3)$.
3. A bag contains 4 red and 6 black balls. Three balls are drawn at random without replacement. Let X be the number of red balls. Construct the probability distribution of X .
4. Find the value of k such that the function $P(X = x) = k \binom{3}{x} \binom{5}{2-x}$ for $x = 0, 1, 2$ is a valid probability mass function.
5. A random variable X takes values $n = 1, 2, 3, \dots$ with probability $P(X = n) = \frac{1}{2^n}$. Calculate $P(X \text{ is a multiple of } 3)$.
6. For a random variable X , $P(X = k) = a \left(\frac{2}{3}\right)^k$ for $k = 1, 2, 3, \dots$. Determine the constant a .
7. Two cards are drawn from a pack of 52 cards without replacement. Let X be the number of face cards (Kings, Queens, Jacks). Find the probability $P(X = 1)$.
8. A discrete random variable X has the PMF $P(x) = \frac{k}{x!}$ for $x = 0, 1, 2, 3$. Find k .
9. In a game, a person wins 5 units if a spade appears on a draw from a pack of cards, and loses 2 units otherwise. Let X be the amount won or lost. Find the expected value $E(X)$.
10. Let X be a random variable with $P(X = x) = \frac{k}{2^x}$ for $x = 1, 2, 3, 4, 5$. Find $P(X \text{ is even})$.
11. A pair of dice is thrown 3 times. Let X be the number of times a total of 9 is obtained. Construct the probability distribution.
12. If $P(X = x) = \frac{x+1}{k}$ for $x = 0, 1, 2, \dots, n$, find the value of k in terms of n .
13. An urn contains 5 white and 3 red balls. If 2 balls are drawn at random without replacement, find the probability distribution of the number of red balls.
14. Let X be the number of tails in n tosses of a fair coin. If $P(X = 4), P(X = 5)$ and $P(X = 6)$ are in Arithmetic Progression, find the value of n .
15. A random variable X has $P(X = x) = k \cdot 2^{-|x|}$ for $x = -1, 0, 1$. Find k .
16. Find the Mean (Expectation) of a random variable X which takes values 1, 2, 3 with probabilities $1/6, 1/3, 1/2$ respectively.
17. A box contains 2 defective and 4 non-defective items. Items are drawn one by one without replacement until both defective items are found. Let X be the number of draws. Find $P(X = 3)$.
18. Let X be a random variable such that $P(X = x) = \frac{{}^nC_x}{2^n}$ for $x = 0, 1, \dots, n$. Show that $\sum P(X = x) = 1$.
19. If the probability of hitting a target is $1/4$ and X is the number of hits in 4 shots, find $P(X \geq 1)$.
20. Let X be a random variable with range $\{1, 2, 3, \dots\}$. If $P(X = k + 1) = \frac{1}{2}P(X = k)$, find $P(X = 1)$.

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