CUET (UG) – MATHEMATICS

Chapter Test - Probability Distributions: Random Variables

SOLUTIONS

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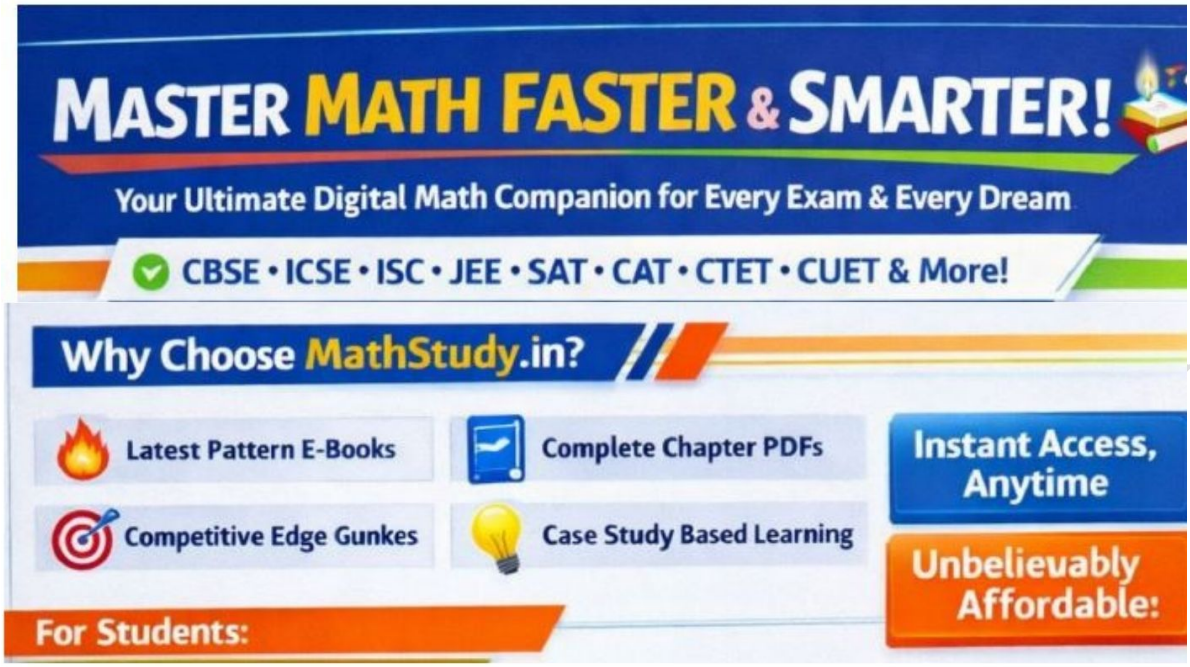

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Solutions

1. Sum of probabilities = 1.
   $0.1 + k + 0.2 + 2k + 0.3 = 1 \implies 3k + 0.6 = 1 \implies 3k = 0.4 \implies k = 0.1333...$
   Correct Option: **(C)**

2. By the Axioms of Probability, the sum of probabilities for all possible outcomes of a random variable must equal 1.
   Correct Option: **(C)**

3. $Var(X) = E(X^2) - [E(X)]^2 = 25 - (4)^2 = 25 - 16 = 9$.
   Correct Option: **(A)**

4. Using linearity of expectation: $E(3X + 5) = 3E(X) + 5 = 3(3) + 5 = 14$.
   Correct Option: **(A)**

5. The number of heads can range from 0 (TTT) to 3 (HHH).
   Correct Option: **(C)**

6. $E(X) = \sum xP(x) = \frac{1(1)}{15} + \frac{2(2)}{15} + \frac{3(3)}{15} + \frac{4(4)}{15} + \frac{5(5)}{15} = \frac{1+4+9+16+25}{15} = \frac{55}{15} = \frac{11}{3}$.
   Correct Option: **(C)**

7. $Var(aX + b) = a^2 Var(X)$.
   $Var(2X + 3) = 2^2(4) = 4 \times 4 = 16$.
   Correct Option: **(C)**

8. $E(3X^2) = 3E(X^2) = 3[0^2(1/3) + 1^2(1/6) + 2^2(1/2)] = 3[0 + 1/6 + 2] = 3[13/6] = 6.5$.
   Correct Option: **(A)**

9. In 5 tosses, you can get minimum 0 tails and maximum 5 tails.
   Correct Option: **(C)**

10. $\sum P(x) = 1 \implies C(2^0 + 2^1 + 2^2) = 1 \implies C(1 + 2 + 4) = 1 \implies 7C = 1 \implies C = 1/7$.
    Correct Option: **(A)**

11. Standard Deviation $\sigma = \sqrt{Var(X)} = 5$.
    C.V. $= (\sigma/\text{mean}) \times 100 = (5/10) \times 100 = 50\%$.
    Correct Option: **(A)**

12. $E(X) = \frac{1+2+3+4+5+6}{6} = \frac{21}{6} = 3.5$.
    Correct Option: **(B)**

13. A constant does not vary; $E(a) = a$, so $Var(a) = E(a^2) - [E(a)]^2 = a^2 - a^2 = 0$.
    Correct Option: **(D)**

14. $E(X - \mu) = E(X) - E(\mu) = \mu - \mu = 0$.
    Correct Option: **(B)**

15. $P(R) = 2/5, P(B) = 3/5$.
    $P(X = 1) = P(RB) + P(BR) = (2/5 \times 3/5) + (3/5 \times 2/5) = 6/25 + 6/25 = 12/25$.
    Correct Option: **(C)**

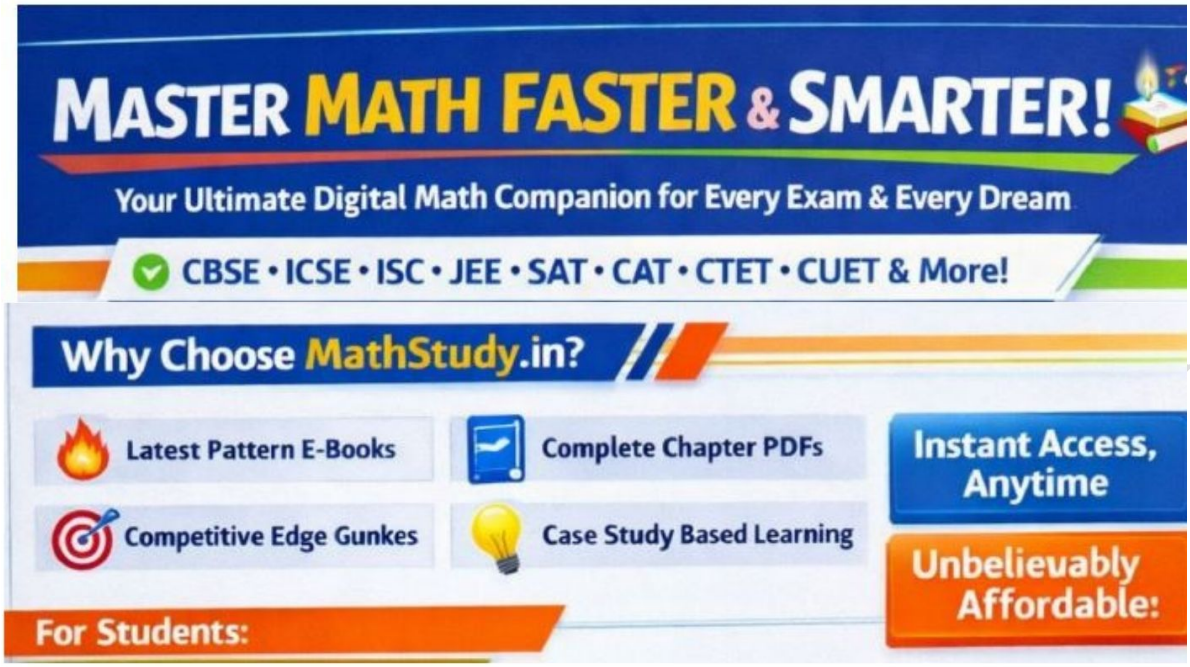
16. Probability values must be between 0 and 1 inclusive. Option (C) has a negative probability.
    Correct Option: **(C)**

17. Property: $Var(kX) = k^2 Var(X)$.
    Correct Option: **(B)**

18. $E(X) = 0.5, E(X^2) = 0.5$.
$Var(X) = 0.5 - (0.5)^2 = 0.25$.
$\sigma = \sqrt{0.25} = 0.5$.
Correct Option: **(A)**

19. $\sum P(x) = 1 \implies k(1+2+3) + k(6-4) + k(6-5) = 1 \implies 6k + 2k + k = 1 \implies 9k = 1 \implies k = 1/9$.
Correct Option: **(B)**

20. $E(X^2 + 2X) = E(X^2) + 2E(X)$.
$Var(X) = E(X^2) - [E(X)]^2 \implies 1 = E(X^2) - 4 \implies E(X^2) = 5$.
$E(X^2 + 2X) = 5 + 2(2) = 9$.
Correct Option: **(C)**



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