MATHS

BOOKS - SURA MATHS (TAMIL ENGLISH)

PROBABILITY DISTRIBUTIONS

Exercise 11 1

1. Suppose X is the number of tails occurred when three fair coins are tossed once

simultaneously. Find the values of the random variable X and number of points in its inverse images.

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2. In a pack of 52 playing cards, two cards are drawn at random simultaneously. If the number of black cards drawn is a random variable, find the values of the random variable and number of points in its inverse images.

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3. An urn contains 5 mangoes and 4 apples. Three fruits are taken at random. If the number of apples taken is a random variable, then find the values of the random variable and number of points in its inverse images.

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4. Two balls are chosen randomly from an urn containing 6 red and 8 black balls. Suppose that we win Rs. 15 for each red ball selected

and we lose Rs. 10 for each black ball selected. X denotes the winning amount, then find the values of X and number of points in its inverse images.

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5. A six sided die is marked '2' on one face, '3' on two of its faces, and '4' on remaining three faces. The die is thrown twice. If X denotes the total score in two throws, find the values of

the random variable and number of points in its inverse images.

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Exercise 11 2

1. Three fair coins are tossed simultaneously. Find the probability mass function for number of heads occurred.

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2. A six sided die is marked '1' on one face, '3' on two of its faces, and '5' on remaining three faces. The die is thrown twice. If X denotes the total score in two throws, find

the probability mass function

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3. A six sided die is marked '1' on one face, '3' on two of its faces, and '5' on remaining three faces. The die is thrown twice. If X denotes the

total score in two throws, find

the cumculative distribution function

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4. A six sided die is marked '1' on one face, '3' on two of its faces, and '5' on remaining three faces. The die is thrown twice. If X denotes the total score in two throws, find

$P(4 \leq X \leq 10)$

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5. A six sided die is marked '1' on one face, '3' on two of its faces, and '5' on remaining three faces. The die is thrown twice. If X denotes the total score in two throws, find

$P(X \geq 6)$

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6. Find the probability mass function and cumculative distribution function of number of girl child in families with 4 children,

assuming equal probabilities for boys and girls.

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7. Suppose a discrete random variable can only take the values 0, 1, and 2. The probability mass function is defined by

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

Find (i) the value of k (ii) cumculative distribution function (iii) $P(X \geq 1)$.

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8. The cumculative distribution function of a discrete random variable is given by

$$F(x) = \begin{cases} 0 & -\infty < x < -1 \\ 0.15 & -1 \leq x < 0 \\ 0.35 & 0 \leq x < 1 \\ 0.60 & 1 \leq x < 2 \\ 0.85 & 2 \leq x < 3 \\ 1 & 3 \leq x < \infty \end{cases}$$

Find (i) the probability mass function (ii) $P(X < 1)$ and (iii) $P(X \geq 2)$.

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9. The cumculative distribution function of a discrete random variable is given by

$$F(x) = \begin{cases} 0 & \text{for } -\infty < x < 0 \\ \frac{1}{2} & \text{for } 0 \leq x < 1 \\ \frac{3}{5} & \text{for } 1 \leq x < 2 \\ \frac{4}{5} & \text{for } 2 \leq x < 3 \\ \frac{9}{10} & \text{for } 3 \leq x < 4 \\ 1 & \text{for } 4 \leq x < \infty \end{cases}$$

Find (i) the probability mass function (ii) $P(X < 3)$ and (iii) $P(X \geq 2)$.

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Exercise 11 3

1. The probability density function of X is given by $f(x) = \begin{cases} kxe^{-2x} & \text{for } x > 0 \\ 0 & \text{for } x \leq 0 \end{cases}$ Find the value of k.

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2. The probability density function of X is

$$f(x) = \begin{cases} x & 0 < x < 1 \\ 2 - x & 1 \leq x < 2 \\ 0 & \text{otherwise} \end{cases}$$

Find

$P(0.2 \leq X < 0.6)$

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3. The probability density function of X is

$$f(x) = \begin{cases} x & 0 < x < 1 \\ 2 - x & 1 \leq x < 2 \\ 0 & \text{otherwise} \end{cases}$$

Find

$P(1.2 \leq X < 1.8)$

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4. The probability density function of X is

$$f(x) = \begin{cases} x & 0 < x < 1 \\ 2 - x & 1 \leq x < 2 \\ 0 & \text{otherwise} \end{cases}$$

Find

$P(0.5 \leq X < 1.5)$

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5. Suppose the amount of milk sold daily at a milk booth is distributed with a minimum of 200 litres and a maximum of 600 litres with probability density function

$$f(x) = \begin{cases} k & 200 \leq x \leq 600 \\ 0 & \text{otherwise} \end{cases}$$

Find

the value of k

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6. Suppose the amount of milk sold daily at a milk booth is distributed with a minimum of 200 litres and a maximum of 600 litres with probability density function

$$f(x) = \begin{cases} k & 200 \leq x \leq 600 \\ 0 & \text{otherwise} \end{cases}$$

Find

the distribution function

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7. Suppose the amount of milk sold daily at a milk booth is distributed with a minimum of 200 litres and a maximum of 600 litres with probability density function

$$f(x) = \begin{cases} k & 200 \leq x \leq 600 \\ 0 & \text{otherwise} \end{cases}$$

Find

the probability that daily sales will fall between 300 litres and 500 litres?

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8. The probability density function of X is given by $f(x) = \begin{cases} ke^{-\frac{x}{3}} & \text{for } x > 0 \\ 0 & \text{for } x \leq 0 \end{cases}$

Find

the value of k

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9. The probability density function of X is given by $f(x) = \begin{cases} ke^{-\frac{x}{3}} & \text{for } x > 0 \\ 0 & \text{for } x \leq 0 \end{cases}$

Find

the distribution function

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10. The probability density function of X is given by $f(x) = \begin{cases} ke^{-\frac{x}{3}} & \text{for } x > 0 \\ 0 & \text{for } x \leq 0 \end{cases}$

Find

$P(X < 3)$

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11. The probability density function of X is given by $f(x) = \begin{cases} ke^{-\frac{x}{3}} & \text{for } x > 0 \\ 0 & \text{for } x \leq 0 \end{cases}$

Find

$P(5 \leq X)$

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12. The probability density function of X is given by $f(x) = \begin{cases} ke^{-\frac{x}{3}} & \text{for } x > 0 \\ 0 & \text{for } x \leq 0 \end{cases}$

Find

$P(X \leq 4)$

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13. If X is the random variable with probability density function f(x) is given by

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

then find (i) the distribution function F(x) (ii) $P(-0.5 \leq X \leq 0.5)$

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14. If X is the random variable with distribution function F(x) given by,

$$F(x) = \begin{cases} 0 & x < 0 \\ \frac{1}{2}\left(x^2 + x\right) & 0 \leq x < 1 \\ 1 & x \leq 1 \end{cases}$$

then find (i) the probability density function f(x) (ii) $P(0.3 \leq X \leq 0.6)$

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Exercise 11 4

1. For the random variable X with the given probability mass function as below, find the mean and variance.

$$f(x) = \begin{cases} \frac{1}{10} & x = 2,5 \\ \frac{1}{5} & x = 0,1,3,4 \end{cases}$$

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2. For the random variable X with the given probability mass function as below, find the mean and variance.

$$f(x) = \begin{cases} \frac{4-x}{6} & x = 1, 2, 3 \end{cases}$$

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3. For the random variable X with the given probability mass function as below, find the mean and variance.

$$F(x) = \begin{cases} 2(x-1) & 1 < x < 2 \\ 0 & \text{otherwise} \end{cases}$$

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4. For the random variable X with the given probability mass function as below, find the

mean and variance.

$$F(x) = \begin{cases} \frac{1}{2}e^{-\frac{x}{2}} & \text{for} \quad x > 0 \\ 0 & \text{otherwise} \end{cases}$$

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5. Two balls are drawn in succession without replacement from an urn containing four red balls and three black balls. Let X be the possible outcomes drawing red balls. Find the probability mass function and mean for X.

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6. If μ and σ^2 are the mean and variance of the discrete random variable X, and $E(X+3)=10$ and $E(X+3)^2=116$, find μ and σ^2.

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7. Four fair coins are tossed once. Find the probability mass function, mean and variance for number of heads occurred.

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8. A commuter train arrives punctually at a station every half hour. Each morning, a student leaves his house to the train station. Let x denote the amount of time, in minutes, that the student waits for the train from the time he reaches the train station. It is known that the pdf of X is $f(x) = \begin{cases} \frac{1}{30} & 0 < x < 30 \\ 0 & \text{elsewhere} \end{cases}$. Obtain interpret the expected value of the random variable X.

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9. The time to failure in thousands of hours of an electronic equipment used in a manufactured computer has the density function

$$f(x) = \begin{cases} 3e^{-3x} & x > 0 \\ 0 & \text{elsewhere} \end{cases}$$

Find the expected life of this electronic equipment.

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10. The probability density function of the random variable X is given by

$$f(x) = \begin{cases} 16xe^{-4x} & \text{for } x > 0 \\ 0 & \text{for } x \leq 0 \end{cases}$$ find the mean and variance of X

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11. A lottery with 600 tickets gives one prize of Rs. 200, four prizes of Rs. 100, and six prizes of Rs. 50. If the ticket costs is Rs. 2, find the expected winning amount of a ticket.

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Exercise 11 5

1. Compute P(X=k) for the binominal distribution, B(n,p) where

$n = 6, p = \frac{1}{3}, k = 3$

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2. Compute P(X=k) for the binominal distribution, B(n,p) where

$n = 10, p = \frac{1}{5}, k = 4$

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3. Compute P(X=k) for the binominal distribution, B(n,p) where

$n = 9, p = \frac{1}{2}, k = 7$

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4. The probability that Mr. Q hits a target at any trial is $\frac{1}{4}$. Suppose he tries at the target

10 times. Find the probability that he hits the target (i) exactly 4 times (ii) at least one time.

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5. Using binomial distribution find the mean and variance of X for the following experiments

A fair coin is tossed 100 times, and X denote the number of heads.

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6. Using binomial distribution find the mean and variance of X for the following experiments

A fair die is tossed 240 times, and X denote the number of times that four appeared.

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7. The probability that a certain kind of component will survive a electrical test is $\frac{3}{4}$. Find the probability that exactly 3 of the 5 components tested survive.

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8. A retailer purchases a certain kind of electronic device from a manufacturer. The manufacturer indicates that the defective rate of the device is 5%. The inspector of the retailer randomly picks 10 items from a shipment. What is the probability that there will be (i) at least one defective item (ii) exactly two defective items.

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9. If the probability that a fluorescent light has a useful life of at least 600 hours is 0.9, find the probabilities that among 12 such lights exactly 10 will have a useful life of at least 600 hours,

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10. If the probability that a fluorescent light has a useful life of at least 600 hours is 0.9, find the probabilities that among 12 such

lights

at least 11 will have a useful life of at least 600 hours,

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11. The mean and standard deviation of a binomial variate X are respectively 6 and 2. Find (i) the probability mass function (ii) P(X=3) (iii) $P(X \geq 2)$.

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12. If $X \sim B(n,p)$ such that $4P(X=4)=P(X=2)$ and $n=6$. Find the distribution, mean and standard deviation of X.

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13. In a binomial distribution consisting of 5 independent trials, the probability of 1 and 2 successes are 0.4096 and 0.2048 respectively. Find the mean and variance of the random variables.

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Exercise 11 6

1. Let X be random variable with probability density function

$$f(x) = \begin{cases} \frac{2}{x^3} & x \geq 1 \\ 0 & x < 1 \end{cases}$$

Which of the following statement is correct

A. both mean and variance exist

B. mean exists but variance does not exist

C. both mean and variance do not exist

D. variance exists but Mean does not exist

Answer: B

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2. A rod of length 2l is broken into two pieces at random. The probability density function of the shorter of the two pieces is

$$f(x) = \begin{cases} \frac{1}{l} & 0 < x \geq l \\ 0 & l \leq x < 2l \end{cases}$$

The mean and variance of the shorter of the two pieces are respectively

A. $\frac{l}{2}, \frac{l^2}{3}$

B. $\frac{l}{2}, \frac{l^2}{6}$

C. $1, \frac{l^2}{12}$

D. $\frac{l}{2}, \frac{l^2}{12}$

Answer: D

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3. Consider a game where the player tosses a six sided fair die. If the face that comes up is 6, the player wins Rs. 36, otherwise he loses Rs.

k^2, where k is the face that comes up k = {1, 2, 3, 4, 5}.

The expected amount to win at this game in Rs. is

A. $\frac{19}{6}$

B. $-\frac{19}{6}$

C. $\frac{3}{2}$

D. $-\frac{3}{2}$

Answer: B

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4. A pair of dice numbered 1, 2, 3, 4, 5, 6 of a six-sided die and 1, 2, 3, 4 of a four-sided die is rolled and the sum is determined. Let the random variable X denote this sum. Then the number of elements in the inverse image of 7 is

A. 1

B. 2

C. 3

D. 4

Answer: D

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5. A random variable X has binominal distribution with n = 25 and p = 0.8 then standard deviation of X is

A. 6

B. 4

C. 3

D. 2

Answer: D

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6. Let X represent the difference between the number of heads and the number of tails obtained when a coin is tossed n times. Then the possible values of X are

A. $i + 2n, i = 1, 2...n$

B. $2i - n, i = 0, 1...n$

C. $n - i, i = 0, 1, 2...n$

D. $2i + 2n, i = 0, 1, 2 \ldots n$

Answer: B

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7. If the function $f(x) = \frac{1}{12}$ for $a < x < b$, represents a probability density function of a continuous random variable X, then which of the following cannot be the value of a and b?

A. 0 and 12

B. 5 and 17

C. 7 and 19

D. 16 and 24

Answer: D

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8. Four buses carrying 160 students from the same school arrive at a football stadium. The buses carry, respectively, 42, 36, 34, and 48 students. One of the students is randomly

selected. Let X denote the number of students that were on the bus carrying the randomly selected student. Let Y denote the number of students on that bus. Then E[X] and E[Y] respectively are

A. 50, 40

B. 40, 50

C. 40.75, 40

D. 41, 41

Answer: C

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9. Two coins are to be flipped. The first coin will land on heads with probability 0.6, the second with probability 0.5. Assume that the results of the flips are independent, and let X equal the total number of heads that result. The value of E[X] is

A. 0.11

B. 1.1

C. 11

D. 1

Answer: B

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10. On a multiple-choice exam with 3 possible destructive for each of the 5 questions, the probability that a student will get 4 or more correct answers just by guessing is

A. $\frac{11}{243}$

B. $\frac{3}{8}$

C. $\frac{1}{243}$

D. $\frac{5}{243}$

Answer: A

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11. If P{X=0}=1-P{X=1}. If E{X}=3Var(X), then P{X=0} is

A. $\frac{2}{3}$

B. $\frac{2}{5}$

C. $\frac{1}{5}$

D. $\frac{1}{3}$

Answer: D

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12. If X is a binomial random variable with expected value 6 and variance 2.4, then P(X=5) is

A. $\binom{10}{5}\left(\frac{3}{5}\right)^{6}\left(\frac{2}{5}\right)^{4}$

B. $\binom{10}{5}\left(\frac{3}{5}\right)^{5}$

C. $\binom{10}{5}\left(\frac{3}{5}\right)^{4}\left(\frac{2}{5}\right)^{6}$

D. $\binom{10}{5}\left(\frac{3}{5}\right)^{5}\left(\frac{2}{5}\right)^{5}$

Answer: D

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13. The random variable X has the probability density function

$f(x) = \begin{cases} ax + b & 0 < x < 1 \\ 0 & \text{otherwise} \end{cases}$ and $E(X) = \frac{7}{12}$, then a and b are respectively

A. 1 and $\frac{1}{2}$

B. $\frac{1}{2}$ and 1

C. 2 and 1

D. 1 and 2

Answer: A

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14. Suppose that X takes on one of the values 0, 1, and 2. If for some constant k, P(X=i)=k P(X=i-1)i=1,2 and P(X=0)=$\frac{1}{7}$ then the value of k is

A. 1

B. 2

C. 3

D. 4

Answer: B

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15. Which of the following is a discrete random variable?

I. The number of cars crossing a particular signal in a day.

II. The number of customers in a queue to buy train tickets at a moment.

III. The time taken to complete a telephone call.

A. I and II

B. II only.

C. III only

D. II and III

Answer: A

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16. If $f(x) = \begin{cases} 2x & 0 \leq x \leq a \\ 0 & \text{otherwise} \end{cases}$ is a probability density function of a random variable, then the value of a is

A. 1

B. 2

C. 3

D. 4

Answer: A

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17. Let X have a Bernoulli distribution with mean 0.4, then the variance of (2X-3) is

A. 0.24

B. 0.48

C. 0.6

D. 0.96

Answer: D

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18. If in 6 trials, X is a binomial variate which follows the relation $9P(X=4)=P(X=2)$, then the probability of success is

A. 0.125

B. 0.25

C. 0.375

D. 0.75

Answer: B

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19. A computer salesperson knows from his past experience that he sells computers to one in every twenty customers who enter the

showroom. What is the probability that he will sell a computer to exactly two of the next three customers?

A. $\frac{57}{20^3}$

B. $\frac{57}{20^2}$

C. $\frac{19}{20^3}$

D. $\frac{57}{20}$

Answer: A

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Government Exam Questions 2 Mark

1. Find the mean of a random variable X, whose probability density function is $f(x) = \begin{cases} \lambda e^{-\lambda x} & \text{for} \quad x \geq 0 \\ 0 & \text{otherwise} \end{cases}$.

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Additional Questions 1 Marks

1. If F(x) is the probability distribution function then $F(-\infty)$ is

A. 1

B. 2

C. ∞

D. 0

Answer: D

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2. If F(x) is the probability distribution function, then $F(\infty)$ is

A. 1

B. 2

C. ∞

D. 0

Answer: A

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3. If $E(x) = \frac{1}{2}, E(x^2) = \frac{1}{4}$ then var(x) is

A. 0

B. $\frac{1}{4}$

C. $\frac{1}{2}$

D. 1

Answer: A

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4. If $f(x) = Cx^2, o < x < 2$ is the p.d.f. of x then c is

A. $\frac{1}{3}$

B. $\frac{4}{3}$

C. $\frac{8}{3}$

D. $\frac{3}{8}$

Answer: D

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5. If a random variable X has the p.d.f. $f(x) = \frac{k}{x^2+1}, 0 < x < \infty$, then k is

A. π

B. $\frac{1}{\pi}$

C. 1

D. $\frac{2}{\pi}$

Answer: D

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6. In eight throws of a die, 1 or 3 is considered a success. Then the mean number of success is

A. $\frac{8}{3}$

B. $\frac{4}{3}$

C. $\frac{2}{3}$

D. $\frac{5}{3}$

Answer: A

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7. The random variable X has variance 4 and $E(x^2) = 8$, then the mean of x is

A. $2\sqrt{3}$

B. 4

C. 2

D. $\sqrt{2}$

Answer: C

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8. In a binomial distribution, if the mean is 8 and the variance is 6, then the number of trials is

A. 32

B. 48

C. 16

D. 12

Answer: A

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9. In a binomial distribution, $n = 4, P(X = 0) = \frac{16}{81}$, then P(X=4).

A. $\frac{1}{16}$

B. $\frac{1}{81}$

C. $\frac{1}{27}$

D. $\frac{1}{8}$

Answer: B

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10. A die is tossed 5 times Getting an odd number is considered a success. Then the variance of distribution of number of success is

A. $\frac{8}{3}$

B. $\frac{3}{8}$

C. $\frac{4}{5}$

D. $\frac{5}{4}$

Answer: D

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11. $Var(2x \pm 5)$ is = _____.

A. 5

B. $var(2x) \pm 5$

C. 4 var (X)

D. 0

Answer: C

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12. If the p.d.f. $f(x) = \begin{cases} \frac{x}{2}, & 0 < x < 2 \\ 0, & \text{elsewhere} \end{cases}$ then $E(3x^2 - 2x) =$ _____.

A. $\frac{2}{3}$

B. $\frac{4}{3}$

C. $\frac{10}{3}$

D. $\frac{7}{3}$

Answer: C

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13. The variance of a binomial distribution is _____.

A. equal to its mean

B. less than its mean

C. greater than its mean

D. none

Answer: B

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14. In a binomial distribution $n = 4, P(X = 0) = \frac{16}{81}$, then P(X=4) is _____.

A. $\frac{1}{16}$

B. $\frac{1}{81}$

C. $\frac{1}{27}$

D. $\frac{1}{8}$

Answer: B

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15. A coin is tossed 3 times. The probability of getting exactly 2 heads is _____.

A. $\frac{1}{2}$

B. $\frac{1}{8}$

C. $\frac{3}{8}$

D. $\frac{1}{4}$

Answer: C

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16. The sum of the mean and variance of a binomial distribution for 6 total is 2.16. Then the probability of success p = _____.

A. 0.4

B. 0.6

C. 0.8

D. 0.2

Answer: D

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17. If the mean and variance of a binomial variate are 2 and 1 respectively, the probability that X takes a value greater than one is equal to _____.

A. $\frac{5}{16}$

B. $\frac{11}{16}$

C. $\frac{10}{16}$

D. $\frac{1}{2}$

Answer: B

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18. A die is thrown 10 times. Getting a number greater than 3 is considered a success. The S.D of the number of successses is _____.

A. 2.5

B. 1.58

C. 5

D. 25

Answer: B

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19. If X is a continuous random variable then $P(X \geq a) =$ _____.

A. $P(X < a)$

B. $1 - P(X > a)$

C. $P(X > a)$

D. $1 - P(X \leq a - 1)$

Answer: C

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20. If X is a continuous random variable then $p(a < x < b) =$ _____.

A. $P(a \leq X \leq b)$

B. $P(a < X \leq b)$

C. $P(a \leq X < b)$

D. all of these

Answer: D

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21. If X is a continuous random variable then which of the following is incorrect?

A. $F'(x) = f(x)$

B. $F(\infty) = 1, F(-\infty) = 0$

C. $P(a \leq X \leq b) = F(b) - F(a)$

D. $P(a \leq X < b) \neq F(b) - F(a)$

Answer: D

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22. If F(x) is a distribution function of a random variable then the false statement is

A. $F(\infty) = 1$

B. $F(-\infty) = -1$

C. $F'(x) = f(x)$

D. $0 < F(x) < 1$

Answer: B

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23. If the mean and S.D of a binomial distribution are 12 and 2 respectively, then

A. npq = 4

B. $q = \frac{1}{3}$

C. $p = \frac{2}{3}$

D. $pq = \frac{1}{9}$

Answer: B

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24. For a Bernouli distribution

A. $\sigma = \sqrt{npq}$

B. mean $= \mu$

C. $\mu = p$

D. $\sigma^2 = pq$

Answer: A

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Additional Questions 2 Marks

1. If the mean of the binomial distribution with 9 trial is 6, find the variance?

2. If 10 coins are tossed, find the probability that exactly 5 heads appears.

3. If the p.d.f of a random variable X is given by $f(x) = \frac{2x}{9}, 0 < x < 3$, then find E(3X+8).

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4. Suppose X is a binomial variate $X \sim B(5, p)$ and P(X=2)=P(X=3), then find p.

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Additional Questions 3 Marks

1. If a continuous random variable X has the p.d.f. $f(x) = 4k(x-1)^3 1 \leq x \leq 3$, then find $P(1 \leq X \leq 2)$.

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2. A player tosses two unbaised coins. He wins Rs. 5 if two heads appear, Rs. 2 if one head appear and Rs. 1 if no head appear. Find the expected amount to win.

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3. The probability that an event A happens in one treat of an experiment is 0.4. Three independent treats of the experiment are performed. Find the probability that the event A happens atleast once?

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4. 20% of the bolts produced in a factory are found to be defective. Find the probability that in a sample of 10 bolts chosen at random,

exactly 2 will be defective using binomial distribution.

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Additional Questions 5 Marks

1. If $f(x) = \begin{cases} Ax & 0 < x < 5 \\ A(10 - x) & 5 \leq x < 10 \end{cases}$ is a p.d.f of a continuous random variable X, then find its mean.

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2. Two cards are drawn successively with replacement for a well shuffled pack of 52 cards. Find the probabilility distribution of the number of kings.

3. A fair coin is tossed until a head or 5 tails occur. If X denote the number of tosses of the coin, find the mean of X.

4. For the distribution function given by $F(x) = \begin{cases} 0, & x < 0 \\ x^2, & 0 \leq x \leq 1 \\ 1, & x > 1 \end{cases}$. Find the density function.

Also evaluate (i) $P(0.5 < x < 0.75)$ (ii) $P(x \leq 0.5)$ (iii) $P(X > 0.75)$

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