MATHS

NCERT - FULL MARKS MATHS(TAMIL)

PROBABILITY

Examples

1. If $P(A)=\frac{7}{13}, P(B)=\frac{9}{13}$ and $P(B \cap A)=\frac{4}{13}$ evaluate P(A|B)

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2. A family has two children. What is the probability that both the children are boys given that at least one of them is a boy ?

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3. Ten cards numbered 1 to 10 are placed in a box, mixed up thoroughly and then one card is drawn randomly. If it is known that the number on the drawn card is more than 3,

what is the probability that it is an even number?

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4. In a school, there are 1000 students, out of which 430 are girls. It is known that out of 430, 10% of girls study in class XII. What is the probability that a student chosen randomly studies in class XII given that the chosen student is a girl.

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5. A die is thrown three times,

A:4 appears on the third toss, B: 6 and 5 appear respectiyely on first two tosses Determine $P(A|B)$.

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6. A die is thrown twice and the sum of the numbers appearing is observed to be 6. What is the conditional probability that the number 4 has appeared at least once?

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7. Consider the experiment of tossing a coin. If the coin shows head, toss it again but if it shows tail, then throw a die. Find the conditional probability of the event that the die shows a number greater than 4' given that there is at least one tail.

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8. An urn contains 10 black and 5 white balls. Two balls are drawn from the urn one after the other without replacement. What is the probability that both drawn balls are black?

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9. Three cards are drawn successively, without replacement from a pack of 52 well shuffled cards. What is the probability that first two cards are kings and the third card is an ace?

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10. A die is thrown. E is the event "the number appearing us a multiple of 3" and F be the event "the number appearing is even". Find whether E and F are independent.

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11. An unbiased die is thrown twice. Let the event A be 'odd number on the first throw' and

B the event 'odd number on the second throw'.

Check the independence of the events A and B.

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12. Three coins are tossed simultaneously. Let the event E 'three heads or three tails', F 'at least two heads' and G 'at most two heads'. Of the pairs (E, F), (E, G) and (F, G), which are independent? which are dependent.

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13. Prove that if E and F are independent events, then so are the events E and F'.

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14. If A and B are two independent events, then the probability of occurrence of at least one of A and B is given by 1- P(A') P(B').

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15. A person has undertaken a construetion job. The probabilities are 0.65 that there will be strike, 0.80 that the construction job will be completed on time it there is no strike and 0.32 that the construction job will be completed on time if there is a strike. Determine the probability that the construction job will be completed on time.

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16. Bag I contains 3 red and 4 black balls while another Bag II contains 5 red and 6 black balls. One ball is drawn at random from one of the bags and it is found to be red. Find the probability that it was drawn from Bag II.

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17. Given three idential boxes I, II and Ill each containing two coins. In box I, both coins are gold coins, in box II, both are silver coins and

in box III, there is one gold coin and one silver coin. A person chooses a box at random and takes out a coin. If the coin is gold, what is the probability that the other coin in the box is also gold.

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18. Suppose that the reliability of a HIV test is specified as follows. Of people having HIV, 90% of the test detect the diséase but 10% go undetected. Of people free of HIV, 99% of the

test judged HIV (-ve) but 1% are diagnosed as showing HIV (+ ve). From a large population of which 0.1% have HIV, one person is selected at random, given the HIV test, and the pathologist report him/her as HIV (+ve) What is the probability that the person actually has HIV?

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19. In a factory which manufactures bolts, machine A, B and C manufacture respectively

25%, 35% and 45% of the bolts. Of their outputs 5, 4 and 2 percent are respectively defective bolts. A bolt is drawn at random from the product and is found to be defective. What is the probability that if is manufactured by machine B?

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20. A doctor is to visit a patient. From the past experience, it is known that the probabilities that he will come by train, bus, scooter or by

other means of transport are respectively $\frac{3}{10}, \frac{1}{5}, \frac{1}{10}$ and $\frac{2}{5}$ and. The probabilities that he will be late are $\frac{1}{4}, \frac{1}{3}$ and $\frac{1}{12}$ and if he comes by train, bus and scooter respectively, but if he comes by other means of transport, then he will not be late. When he comes, he is late. What is the probability that he comes by train?

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21. A man is known to speak truth 3 out of 4 times. He throws a die and reports that it is a six. Find the probability that it is actually a six.

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22. A person plays a game of tossing a coin thrice. For each head, he is given Rs 2 by the organiser of the game and for each tail, he has to give Rs 1.50 to the organiser. Let X denote the amount gained or lost by the person.

Show that X is a random variable and exhibit it as a function on the sample space of the experiment.

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23. A bag contains 2 white and 1 red ball. One ball is drawn át random and then put back in the box after noting its colour. The process is repeated again. If X denotes the number of red balls recorded in the two draws, describe X.

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

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25. Find the probability distribution of number of doublets in three throws of a pair of dice.

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26. Let X denote the number of hours you study during a randomly selected school day. The probability that X can take the values x, has the following form, where k is some unknown constant.

$$P(X=x)=\begin{cases}0.1 & , \quad x=0 \\ kx & , \quad \text{x=1 or 2} \\ k(5-x) & , \quad \text{X=3 or 4} \\ 0 & , \quad \text{otherwise}\end{cases}$$

i. Find the value of k

ii. What is the probability that you study

atleast two hours? Exactly 2 hours? Atmost 2 hours?

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27. A pair of dice is thrown and the random variable X is defined as the sum of numbers that appear on the two dice. Find the mean or expectation of X.

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28. Find the mean and variance of the number obtained on the throw of an unbaised die.

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

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30. Six balls are drawn successively from an urn containing 7 red and 9 black balls. Tell whether or not the trials of drawing balls are Bernoulli trials when after each draw the ball drawn is

(i) replaced (ii) not replaced in the urn.

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31. If a fair coin is tossed 10 times, find the probability of

(i) exactly six heads

(ii) at least six heads

(iii) at most six heads

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32. Ten eggs are drawn successively with replacement from a lot containing 10% defective eggs. Find the probability that there is at least one defective egg.

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33. Coloured balls are distributed in four boxes as shown in the following table.

	Colour			
Box	Black	White	Red	Blue
I	3	4	5	6
II	2	2	2	2
III	1	2	3	1
IV	4	3	1	5

A box is selected at random and then a ball is randomly drawn from the selected box. The colour of the ball is black. What is the probability that ball drawn is from the box III?

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34. Find the mean of the Binomial distribution $B\left(4, \frac{1}{3}\right)$

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35. The probability of a shooter hitting a target is $\frac{3}{4}$. How many minimum number of times must $\mathrm{he/she}$ fire so that the probability of hitting the target at least once is more than 0.99?

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36. A and B throw a die alternatively till one of them gets a '6' and wins the game. Find their respective probabilities of winning, if A starts first.

37. If a machine is correctly set up, it produces 90% acceptable items. If it is incorrectly set up, it produces only 40% acceptable items. Past experience shows that 80% of the set ups are

correctly done. If after a certain set up, the machine produces 2 acceptable items, find the probability that the machine is correctly set up.

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Exercise 3 1

1. Given that E and F are events such that P(E) = 0.6, P(F) = 0.3 and $P(E \cap F) = 0.2$, find P(E|F) and P(F|E).

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2. Compute P(A|B), if P(B) = 0.5 and $P(A \cap B) = 0.32$

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3. If P(A) = 0.8, P(B) = 0.5 and P (B|A) = 0.4, find

(i) $P(A \cap B)$ (ii) P(A|B) (iii) $P(A \cup B)$

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4. Evaluate $P(A \cup B)$ If $2P(A) = P(B) = \frac{5}{13}$ and $P(A/B) = \frac{2}{5}$.

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5. If $P(A) = \frac{6}{11}, P(B) = \frac{5}{11}$ amd $P(A \cup B) = \frac{7}{11}$, find

(i) $P(A \cup B)$ (ii) P(A|B) (iii) P(B|A)

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6. Determine $P(E|F)$

A coin is tossed three times, where

(i) E : head on third toss , F : heads on first two tosses

(ii) E : at least two heads , F : at most two heads

(iii) E : at most two tails F : at least one tail

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7. Determine P(E/F)

Two coins are tossed once, where

i. E: tail appears on one coin,

F: one coin shows head

ii E: no tail appears,

F: no head appears

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8. A die is thrown three times,

A:4 appears on the third toss, B: 6 and 5

appear respectiyely on first two tosses

Determine $P(A|B)$.

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9. Mother, father and son line up at random for a family picture

E: son on one end, F: father in middle

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10. A black and red dice are rolled.

a. Find the conditional probability of obtaining a sum greater than 9, given that the black die resulted in a 5.

b. Find the conditional probability of obtainingthe sum 8, given that the red die resulted in a number less than 4.

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11. A fair die is rolled. Consider events E = {1,3,5}, F = {2,3} and G = {2,3,4,5} Find

(i) P(E|F) and P(F|E) (ii) P(E|G) and P(G|E)

(iii) $P((E \cup F) \mid G)$ and $P((E \cap F) \mid G)$

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12. Assume that each born child is equally likely to be a boy or a girl. If a family has two childeren what is the conditional probability that both gives both are girls given that

i. the youngest is a girl

ii. Atleast one is a girl

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13. An instructor has a question bank consisting of 300 easy True/False questions, 200 difficult True/False questions, 500 easy multiple choice questions and 400 difficult multiple choice questions. If a question is selected at random from the question bank, what is the probability that it will be an easy

question given that it is a multiple choice question?

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14. Given that the two numbers appearing on throwing two dice are different. Find the probability of the event 'the sum of numbers on the dice is 4.

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15. Consider the experiment of throwing a die, if a multiple of 3 comes up, throw the die again and if any other number comes, toss a coin. Find the conditional probabilityof the event 'the coin shows a tail', given that at least one die shows a 3'.

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16. If $P(A) = \frac{1}{2}$, P(B)=0, then P(A|B) is

A. 0

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

C. not defined

D. 1

Answer: C

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17. Choose the correct answer

If A and B are events such that P(A|B) = P(B|A),

then

A. $A \subset B$ but $A \neq B$

B. A = B

C. $A \cap B = \phi$

D. P(A) = P(B)

Answer: D

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Exercise 3 2

1. If $P(A) = \frac{3}{5}$ and $P(B) = \frac{1}{5}$ find $P(A \cap B)$ if A and B are independent events.

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2. Two cards are drawn at random and without replacement from a pack of 52 playing cards. Find the probability that both the cards are black.

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3. A box of oranges is inspected by examining three randomly selected oranges drawn without replacement. If all the three oranges are good, the box is approved for sale, otherwise, it is rejected. Find the probability that a box containing 15 oranges out of which 12 are good and 3 are bad ones will be approved for sale.

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4. A fair coin and an unbiased die are tossed. Let A be the event 'head appears on the coin' and B be the event '3 on the die'. Check whether A and B are independent events or not.

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5. A die marked 1, 2, 3 in red and 4, 5, 6 in green is tossed. Let A be the event, 'the number is

even,' and B be the event, 'the number is red'.

Are A and B independent?

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6. Let E and F be events with $P(E) = \frac{3}{5}, P(F) = \frac{3}{10}$ and $P(E \cap F) = \frac{1}{5}$ Are E and F independent?

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7. Given that the events A and B are such that $P(A) = \frac{1}{2}, P(A \cup B) = \frac{3}{5}$ and P(B) = p. Find p if they are (i) mutually exclusive, (ii) independent.

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8. Let A and B be independent events with P(A) = 0.3 and P(B) = 0.4. Find

(i) $P\left(A \cap B \right)$ (ii) $P(A \cup B)$

(iii) P(A|B) (iv) P(B|A)

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9. If A and B are two events such that $P(A) = \frac{1}{4}, \quad P(B) = \frac{1}{2}$ and $P(A \cap B) = \frac{1}{8}$, find P (not A and not B).

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10. Events A and B are such that $P(A) = \frac{1}{2}, P(B) = \frac{7}{12}$ and $\mathrm{P}(\text{not A or not B}) = \frac{1}{4}$. State whether A and B are independent ?

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11. Given two independent events A and B such that P(A) = 0.3, P(B) = 0.6. Find i. P(A and B) ii. P(A and not B)

iii. P(A or B) iv. P(neither A nor B)

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12. A die is tossed thrice. Find the probability of getting an odd number at least once.

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13. Two balls are drawn at random with replacement from a box containing 10 black and 8 red balls. Find the probability that

i. both balls are red.

ii. first ball is black and second is red.

iii. one of them black and other is red:

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14. Probability of solving specific problem independently by A and B are $\frac{1}{2}$ and $3\frac{1}{3}$ respectively. If both try to solve the problem independently, find the probability that

(i) the problem is solved (ii) exactly one of them solves the problem.

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15. One card is drawn at random from a well shuffled deck of 52 cards. In which of the

following cases are the events E and F independent?

i. E: 'the card drawn is a spade'

F: 'the card drawn is an ace'

ii. E: 'the card drawn is black'

F: 'the card drawn is king'

ii. E: 'the card drawn is a king or queen'

F: 'the card drawn is a queen or jack'.

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16. In a hostel, 60% of the students read Hindi newspaper, 40% read English newspaper and 20% read both Hindi and English newspapers. A student is selected at random.

(a) Find the probability that she reads neither Hindi nor English newspapers.

(b) If she reads Hindi newspaper, find the probability that she reads English newspaper

(c) If she reads English newspaper, find the probability that she reads Hindi newspaper.

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17. Choose the correct answer

The probability of obtaining an even prime number on each die, when a pair of dice is rolled is

A. 0

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

C. $\frac{1}{12}$

D. $\frac{1}{36}$

Answer: D

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18. Choose the correct answer

Two events A and B will be independent, if

A. A and B are mutually exclusive

B. $P(A'B') = [1 - P(A)]\,[1 - P(B)]$

C. $P(A) = P(B)$

D. $P(A) + P(B) = 1$

Answer: B

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Exercise 3 3

1. An urn contains 5 red and 5 black balls. A ball is drawn at random, its colour is noted and is returned to the urn. Moreover, 2 additional balls of the colour drawn are put in the urn and then a ball is drawn at random. The probability that the second ball drawn is red will be

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2. A bag contains 4 red and 4 black balls, another bag contains 2 red and 6 black balls. One of the two bags is selected at random and a ball drawn from the bag which is found to be red. Find the probability that the ball is drawn from the first bag.

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3. Of the students in a college,. it is known that 60% reside in hostel and 40% are day scholars

(not residing in hostel). Previous year results report that 30% of all students who reside in hostel attain A grade and 20% of day scholars attain A grade in their annual examination. At the end of the year, one student is chosen at random from the college and he has an A grade, what is the probability that the student is a hosteler?

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4. In answering a question on a multiple choice test, a student either knows the answer or guesses. Let $\frac{3}{4}$ be the probability that he knows the answer and $\frac{1}{4}$ be the probability that he guesses. Assuming that a student who guesses at the answer will be correct with probability $\frac{1}{4}$. What is the probability that the student knows the answer given that he answered it correctly ?

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5. A laboratory blood test is 99% effective in detecting a certain disease when it is in fact, present. However, the test also yields a false positive result for 0.5% of the healthy person tested (i.e. if a healthy person is tested, then, with probability 0.005, the test will imply he has the disease). If 0.1 percent of the population actually has the disease, what is the probability that a person has the disease given that his test result is positive ?

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6. There are three coins. One is a two headed coin (having head on both faces), another is a biased coin that comes up heads 75% of the time and third is an unbiased coin. One of the three coins is chosen at random and tossed, it shows head, what is the probability that it was the two headed coin?

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7. An insurance company insured 2000 scooter drivers, 4000 car drivers and 6000 truck

drivers. The probability of an accident are 0.01, 0.03 and 0.15 respectively. One of the insured person meets with an accident. What is the probability that he is a scooter driver ?

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8. A factory has two Machines - I and II. Machine - I produces 60% of items and Machine -II produces 40% of the items of the total output . Further 2% of the items produced by Machine-I are defective whereas

4% produced by Machine -II are defective . If an item is drawn at random what is the probability that it is defective ?

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9. Two groups are competing for the position on the Board of Directors of a Corporation. The probabilities that the first and the second groups will win are 0.6 and 0.4 respectively. Further, if the first group wins, the probability of introducing a new product is 0.7 and the

coresponding probability is 0.3 if the second group wins. Find the probability that the new product introduced was by the second group.

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10. Suppose a girl throws a die. If she gets as 5 or 6, she tosses a coin three times and notes the number of heads. If she gets I, 2, 3 or 4, she tosses a coin once and notes whether a head or tail is obtained. If she obtained exactly

one head, wlhat is the probability that she threw 1,2,3 or 4 with the die?

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11. A manufacturer has three machine operators A, B and C. The first operator A produces. 1% defective items, whereas the other two operators B and C produce 5% and 7% defective items respectively. A is on the job for 50% of the time, B is on the job for 30% of the time and C is on the job for 20% of the

time. A defective item is produced. What is the probability that it was produced by A?

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12. A card from a pack of 52 cards is lost. From the remaining cards of the pack, two cards are, drawn and are found to be both diamonds. Find the probability of the lost card being a diamond.

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13. Probability that A speaks truth is $\frac{4}{5}$ A coin is tossed. A reports that a head appears. The probability that there was head is

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

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

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

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

Answer: A

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14. If A and B are two events such that $A \subset B$ and $P(B) \neq 0$, then which of the following is correct ?

A. $P(A \mid B) = \dfrac{P(B)}{P(A)}$

B. $P(A \mid B) < P(A)$

C. $P(A \mid B) \geq P(A)$

D. None of these

Answer: C

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Exercise 3 4

1. State which of the following are not the probability distributions of a random variable. Give reasons for your answer.

i.

X	0	1	2
P(X)	0.4	0.4	0.2

ii.

X	0	1	2	3	4
P(X)	0.1	0.5	0.2	−0.1	0.3

iii.

Y	−1	0	1
P(Y)	0.6	0.1	0.2

iv.

Z	3	2	1	0	−1
P(Z)	0.3	0.2	0.4	0.1	0.05

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2. An urn contains 5 red and 2 black balls. Two balls are randomly drawn. Let X represent the number of black balls. What are the possible values of X? Is X a random variable ?

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3. Let X represent the difference between the number of head and the number of tails obtained when a coin is tossed 6 times. What are possible values of X?

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4. Find the probability distribution of

i. number of head in two tosses of a coin.

ii. number of tails in the simultaneous tosses of three coins.

iii. number of heads in four tosses of a coin.

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5. Find the probability distribution of the number of successes in two tosses of a die, where a success is defined as

i. number greater than 4

ii. six appears on atleast one die

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6. From a lot of 30 bulbs which include 6 defectives, a sample of 4 bulbs is drawn at random with replacement. Find the probability distribution of the number of defective bulbs.

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7. A coin is biased so that the head is 3 times as likely to occur as tail. If the coin is tossed twice, find the probability distribution of number of tails.

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8. A random variable X has the following probability distribution.

X	0	1	2	3	4	5	6	7
P(X)	0	k	$2k$	$2k$	$3k$	k^2	$2k^2$	$7k^2+k$

i. Determine k ii. $P(X < 3)$

iii. P($X > 6$) iv. P($0 < X < 3$)

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9. The random variable X has a probability distribution P(X) of the following form, where k is some number.

$$P(X) = \begin{cases} k & , \quad \text{if} \quad x = 0 \\ 2k & , \quad \text{if x=1} \\ 3k & , \quad \text{x=2} \\ 0 & , \quad \text{otherwise} \end{cases}$$

a. Determine the value of k

b. Find $P(X < 2), IP(X \leq 2), P(X > 2)$.

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10. Find the mean number of heads in three tosses of a fair coin.

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11. Two dice are thrown simultaneously. If X denotes the number of sixes, find the expectation of X.

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12. Two numbers are selected at random (without replacement) from the first six positive integers. Let X denote the larger of the two numbers obtained. Find E(X).

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13. Let X denote the sum of the numbers obtained when two fair dice are rolled. Find the variance and standard deviation of X.

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14. A class has 15 students whose ages are 14, 17, 15, 14, 21, 17, 19, 20, 16, 18, 20, 17, 16, 19 and 20 years. One student is selected such a manner that each has the same chance of being chosen and the age X of the selected student is recorded. What is the probability distribution of the random variable X? Find mean, variance and standard deviation of X.

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15. In a meeting, 70% of the members favour and 30% oppose a certain proposal. A member is selected at random and we take X=0 if he opposed, and X = 1 if he is in favour. Find E(X) and Var (X).

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16. The mean of the numbers obtained on throwing a die having written 1 on three faces, 2 on two faces and 5 on one face is

A. 1

B. 2

C. 5

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

Answer: B

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17. Suppose that two cards are drawn at random from a deck of cards. Let X be the

number of aces obtained. then the value of E(X) is

A. $\frac{37}{221}$

B. $\frac{5}{13}$

C. $\frac{1}{13}$

D. $\frac{2}{13}$

Answer: D

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Exercise 3 5

1. A die is thrown 6 times If 'getting an odd number' is a success, what is the probability of

i. 5 successes?

ii. atleast 5, successes? iii. atmost 5 successes?

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2. A pair of dice is thrown 4 times. If getting a doublet is considered a success, find the probability of two successes.

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3. There are 5% defective items in a large bulk of items. What is the probability that a sample of 10 items will include not more than one defective item?

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4. Five cards are drawn successively with replacement from a well-shuffled deck of 52 cards . What is the probability that

i. all the five cards are spades?

ii only 3 cards are spades?

iii. none is a spade?

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5. The probability that a bulb produced by a factory will fuse after 150 days of use is 0. 05. find the probability that out of 5 such bulbs.

i. none

ii. not more than one

iii. more than one

iv. atleast one

will fuse after 150 days of use.

6. A bag consists of 10 balls each marked with one of the digits 0 to 9. If four balls are drawn successively with replacement from the bag, what is the probability that none is marked with the digit 0?.

7. In an examination 20 questions of true false type are asked. Suppose a student tosses a fair coin to determine his answer to each question. If the coin falls head, he answers 'true', if it falls tail, he answers 'false'. Find the probability that he answers atlest 12 questions correctly.

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8. Suppose X has a binomial distribution $B\left(6, \frac{1}{2}\right)$. Show that X = 3 is the most likely

outcome. (Hint: P(X = 3) is the maximum among all $P(x_1), x_1 = 0, 1, 2, 3, 4, 5, 6$)

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9. On a multiple choice examination with three possible answers for each of the five questions, what is the probability that a candidate would get four or more correct answers just by guessing?

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10. A person buys a lottery ticket in 50 lotteries, in each of which his chance of winning a prize is $\frac{1}{100}$. What is the probability that he will win a prize

a. atleast once

b. exactly once

c. atleast twice?

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11. Find the probability of getting 5 exactly twice in 7 throws of a die.

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12. Find the prabability of throwing atmost 2 sixes in 6 throws of a single die

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13. It is known that 10% of certain articles manufactured are defective. What is the probability that in a random sample of 12 such articles, 9 are defective?

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14. Choose the correct answer:

In a box containing 100 bulbs, 10 are defective. The probability that out of a sample of 5 bulbs, none is defective is

A. 10^{-1}

B. $\left(\frac{1}{2}\right)^5$

C. $\left(\frac{9}{10}\right)^5$

D. $\frac{9}{10}$

Answer: C

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15. The probability that a student is not a swimmer is $\frac{1}{5}$ Then the probability that out of five students, four are swimmers is

A. ${}^5C_4\left(\frac{4}{5}\right)^4\frac{1}{5}$

B. $\left(\frac{4}{5}\right)^4\frac{1}{5}$

C. ${}^5C_1\frac{1}{5}\left(\frac{4}{4}\right)^4$

D. None of these

Answer: A

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Miscellaneous Exercise On Chapter 13

1. A and B are two events such that $P(A) \neq 0$. Find P(B/A) if (i) A is a subset of B (ii) $A \cap B = \phi$

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2. A couple has two children. Find the probability that both children are males, if it is known that atleast one of the children is male. ii. Find the probability that both children are females, if it is known that the elder child is a female.

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3. Suppose that 5% of men and 0.25% of women have grey hair. A grey haired person is

selected at random. What is the probability of this person being male? Assume that there are equal number of males and females.

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4. Suppose that 90% of people are right-handed. What is the probability that atmost 6 of a random sample of 10 people are right-handed?

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5. An urn contains 25 balls of which 10 balls bear a mark 'X' and remaining 15 bear a mark 'Y'. A ball is drawn at random from the urn, its mark is noted down and it is replaced. If 6 balls are drawn in this way, find the probability that

i. all will bear 'X' mark

ii. not more than 2 will bear 'Y' mark

iii. atlest one ball will bear 'Y' mark

iv. the number of balls with 'X' marks and 'Y' mark will be equal

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6. In a hurdle race, a player has to cross 10 hurdles. The probability that he will clear each hurdle is $\frac{5}{6}$. What is the probability that he will knock down fewer than 2 hurdles?

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7. A die is thrown again and again until three sixes are obtained. Find the probability of obtaining the third six in the sixth throw of the die.

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8. If a leap year is selected at random, what is the chance that it will contain 53 Tuesdays?

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9. An experiment succeeds twice as often as it fails. Find the probability that in the next six trials, there will be atleast 4 successes.

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10. How many times must a man toss a fair coin so that the probability of having at least one head is more than 90%?

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11. In a game, a man wins a rupee for a six and loses a rupee for any other number when a fair die is thrown. The man decided to throw a die thrice but to quit as and when he gets a

six. Find the expected value of the amount he wins/loses.

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12. Suppose we have four boxes A, B, C and D containing coloured marbles as given below:

Box	Marble colour		
	Red	White	Black
A	1	6	3
B	6	2	2
C	8	1	1
D	0	6	4

One of the boxes has been selected at random and a single marble is drawn from it. If the

marble is red, what is the probability that it was drawn from box A? box B?

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13. Assume that the chances of a patient having a heart attack is 40%. It is also assumed that a meditation and yoga course reduce the risk of heart attack by 30% and prescription of certain drug reduces its chance by 25%. At a time a patient can choose any one of the two options with equal

probabilities. It is given that after going through one of the two options the patient selected at random suffers a heart attack. Find the probability that the patient followed a course of meditation and yoga?

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14. If each element of a second order determinant is either zero or one, what is the probability that the value of the determinant is positive? (Assume that the individual entries

of the determinant are chosen independently, each value being assumed with probability $\frac{1}{2}$)

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15. An electronic assembly consists of two sub-systems, say, A and B. From previous -testing procedures, the following probabilities are assumed to be known.

P(A fails)= 0.2

(B fails alone) = 0.15

P(A and B fail)= 0.15 Evaluate the following

probabilities

i. P(A fails|B has failed)

ii. P(A fails alone)

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16. Bag I contains 3 red and 4 black balls and Bag II contains 4 red and 5 black balls. One ball is transferred from Bag I to Bag II and then a ball is drawn from Bag II. The ball so drawn is found to be red in colour. Find the probability that the transferred ball is black.

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17. Choose the correct answer:

If A and B are two events such that $P(A) \neq 0$ and P(B|A) = 1, then

A. $A \subset B$

B. $B \subset A$

C. $B = \phi$

D. $A = \phi$

Answer: A

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18. Choose the correct answer:

If $P(A \mid B) > P(A)$, then which of the following is correct :

A. $P(B \mid A) < P(B)$

B. $P(A \cap B) < P(A).P(B)$

C. $P(B \mid A) > P(B)$

D. P(B|A)=P(B)

Answer: C

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19. Choose the correct answer:

If A and B are any two events such that P(A) + P(B) - P(A and B) = P(A), then

A. $P(B|A)=1$

B. $P(A|B)=1$

C. $P(B|A)=0$

D. $P(A|B)=0$

Answer: B

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Example

1. Two balls are chosen randomly from an urn containing 6 white and 4 black balls. Suppose that we win Rs 30 for each black ball selected and we lose Rs 20 for each white ball selected. If X denotes the winning amount, then find the values of X and number of points in its inverse images.

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2. Two fair coins are tossed simultaneously (equivalent to a fair coin is tossed twice). Find the probability mass function for number of heads occurred.

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3. Find the constant C such that the function

$$f(x) = \begin{cases} Cx^2 & 1 < x < 4 \\ 0 & \text{Otherwise} \end{cases}$$

is a density function, and compute (i)

$P(1.5 < X < 3.5)$ (ii) $P(X \leq 2)$ (iii)

$P(3 < X)$.

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4. If X is the random variable with distribution

functionF(x) given by,

$$F(x) = \begin{cases} 0, & x < 0 \\ x, & 0 \leq x < 1 \\ 1, & 1 \leq x \end{cases}$$

then find (i) the probability density function

f(x) (ii) $P(0.2 < X \leq 0.7)$

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5. The probability density function of random variable X is given by $f(x) = \begin{cases} k & 1 \leq x \leq 5 \\ 0 & \text{otherwise} \end{cases}$ Find (i) Distribution function (ii) $P(X < 3)$ (iii) $P(2 < X < 4)$ (iv) $P(3 \leq X)$

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6. Two balls are chosen randomly from an urn containing 8 white and 4 black balls. Suppose that we win Rs 20 for each black ball selected

and we lose Rs10 for each white ball selected. Find the expected winning amount and variance.

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7. Find the mean and variance 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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8. Find the binomial distribution function for each of the following.

Five fair coins are tossed once and X denotes the number of heads.

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9. Find the binomial distribution function for each of the following.

A fair die is rolled 10 times and X denotes the number of times 4 appeared.

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10. A multiple choice examination has ten questions, each question has four distractors with exactly one correct answer. Suppose a student answers by guessing and if X denotes the number of correct answers, find (i) binomial distribution (ii) probability that the student will get seven correct answers (iii) the probability of getting at least one correct answer.

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11. The mean and variance of a binomial variate X are respectively 2 and 1.5. Find

$P(X = 0)$

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12. The mean and variance of a binomial variate X are respectively 2 and 1.5. Find

$P(X = 1)$

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13. The mean and variance of a binomial variate X are respectively 2 and 1.5. Find

$P(X \geq 1)$

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14. On the average, 20% of the products manufactured by ABC Company are found to be defective. If we select 6 of these products at random and X denote the number of defective products find the probability that (i) two

products are defective (ii) at most one product is defective (iii) at least two products are defective.

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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

$P(4 \leq X < 10)$

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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

$P(X \geq 6)$

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4. Find the probability mass function and cumulative distribution function of number of girl child in families with 4 children, assuming equal probabilities for boys and girls.

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

the value of k

View Text Solution

5. Find the probability mass function and cumulative distribution function of number of girl child in families with 4 children, assuming equal probabilities for boys and girls.

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

$P(X \geq 1)$.

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Exercise 11 3

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

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2. The probability density function of X is

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

$P(0.2 \leq X < 0.6)$

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3. The probability density function of X is

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

$P(1.2 \leq X < 1.8)$

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4. The probability density function of X is

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

$P(0.5 \leq X < 1.5)$

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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

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

the value of k

View Text Solution

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

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

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

View Text Solution

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

the value of k

View Text Solution

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

the distribution function

View Text Solution

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

$P(X < 3)$

View Text Solution

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

$P(5 \leq X)$

View Text Solution

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

$P(X \leq 4)$

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

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

$P(-0.5 \leq X \leq 0.5)$

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

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

the probability density function f(x)

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

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

$P(0.3 \leq X \leq 0.6)$

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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. 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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6. 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 and interpret the expected value of the random variable X .

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7. 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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8. 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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9. 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 ` 2, find the expected winning amount of a ticket.

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Exercise 11 5

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

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

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

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

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3. Compute P(X=k) for the binomial 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 is5%.

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. 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 2 will not have a useful life of at least 600 hours.

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12. 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) $P(X \geq 2)$.

A. $1 - \frac{20}{3}\left(\frac{2}{3}\right)^{17}$

B.

C.

D.

Answer: $\binom{18}{x}\left(\frac{1}{3}\right)^{x}\left(\frac{2}{3}\right)^{18-x}$ **(ii)** $\binom{18}{3}\left(\frac{1}{3}\right)^{3}\left(\frac{2}{3}\right)^{15}$ **(iii)** $1-\frac{20}{3}\left(\frac{2}{3}\right)^{17}$

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13. If X ~ B (n,p) such that 4P (X=4) =P(x=2) and n=6 . Find the distribution mean and standard deviation .

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14. In a binomial distribution consisting of 5 independent trials the probability of 1 and 2 sucesses are 0.4096 and 0.2048 respectively. Find the mean and variance of the distribution .

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Exercise 11 6 Choose The Correct

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

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

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

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

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

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. One of the 4 bus drivers is also randomly selected. 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 destructives 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 $P\{X=0\}$.

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

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

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

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

Answer: D

View Text Solution

12. If X is a binomial random variable with expected value 6 and variance 2.4, Then $P\{X=5\}$ is

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

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

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

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

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, $P(X = i) = kP(X = i - 1)$ for 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. $\frac{19^3}{20^3}$

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

Answer: A

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