



# MATHS

## BOOKS - RD SHARMA MATHS (HINGLISH)

### BINOMIAL DISTRIBUTION

#### Solved Examples And Exercises

1. The sum of mean and variance of a binomial distribution is 15 and the sum of their squares

is 117. Determine the distribution.



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2. Find the binomial distribution for which the mean is 4 and variance 3.



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3. The probability of a man hitting a target is  $\frac{1}{4}$ . How many times must he fire so that the

probability of his hitting the target at least once is greater than  $2/3$ ?



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4. How many dice must be thrown so that there is a better than even chance of obtaining a six?



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5. A die is tossed thrice. Getting an even number is considered as success. What is the variance of the binomial distribution?



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6. The mean and variance of a binomial distribution are 4 and  $\frac{4}{3}$  respectively, find  $P(X \geq 1)$



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7. A die is thrown 20 times. Getting a number greater than 4 is considered a success. Find the mean and variance of the number of successes.



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

(i) 5 successes?

(ii) at least 5 successes?

(iii) at most 5 successes?



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9. A pair of dice is thrown 7 times. If getting a total of 7 is considered a success, what is the probability of

(i) no success?

(ii) 6 success?

(iii) at least 6 success?



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**10.** A urn contains 5 white, 7 red and 8 black balls. If four balls are drawn one by one with replacement, what is the probability that

(i) all are white?

(ii) only 3 are white?

(iii) none is white?

(iv) at last three are white?



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**11.** A die is thrown 5 times. Find the probability that an odd number will come up exactly three times.



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**12.** Five dice are thrown simultaneously. If the occurrence of an even number in a single dice is considered a success, find the probability of at most 3 success.



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**13.** The probability that a student entering university will graduate is 0.4. Find the probability that out of 3 students of the university: (i) none will graduate, (ii) only one will graduate, (iii) all will graduate.



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**14.** Find the probability that in 10 throws of a fair die a score which is a multiple of 3 will be obtained in at least 8 of the throws.



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**15.** The sum and the product of the mean and variance of a binomial distribution are 24 and 128 respectively. Find the distribution.



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**16.** If the sum of the mean and variance of a binomial distribution for 5 trials is 1.8; find the distribution.



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17. If the probability of a defective bolt is 0.1, find the i. mean and ii. standard deviation for the distribution of bolts in a total of 400 bolts.



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18. In a binomial distribution, prove that mean  $>$  variance



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**19.** If  $X$  follows binomial distribution with mean 4 and variance 2, find  $P(|X - 4| \leq 2)$ .



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**20.** If two dice are rolled 12 times, obtain the mean and the variance of the distribution of success, if getting a total greater than 4 is considered a success.



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**21.** 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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**22.** The mean and variance of a binomial variance with parameters  $n$  and  $p$  are 16 and 8

respectively.

Find

$P(X = 0)$ ,  $P(X = 1)$  and  $P(X \geq 2)$ .



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**23.** There are three urns A, B and C. Urn A contains 4 white balls and 5 blue balls. Urn B contains 4 white balls and 3 blue balls. Urn C contains 2 white balls and 4 balls. One ball is drawn from each of these urns. What is the probability that out of these three balls

drawn, two are white balls and one is a blue ball?



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**24.** The probability of a man hitting a target is 0.25. He shoots 7 times. What is the probability of his hitting at least twice?



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**25.** A bag contains 3 red and 4 black balls. One ball is drawn and then replaced in the bag and the process is repeated. Every time the ball drawn is red we say that the draw has resulted in success. Let  $X$  be the number of successes in 3 draws. Assuming that at each draw each ball is equally likely to be selected, find the probability distribution of  $X$ .



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**26.** Two cards are drawn successively with replacement from a well shuffled pack of 52 cards. Find the probability distribution of the number of aces.



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**27.** Assume that the probability that a bomb dropped from an aeroplane will strike a certain target is 0.2. If 6 bombs are dropped find the probability that

(i) exactly 2 will strike the target.

(ii) at least 2 will strike the target.



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**28.** Six coins are tossed simultaneously. Find the probability of getting

(i) 3 heads

(ii) no heads

(iii) at least one head



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**29.** Six dice are thrown 729 times. How many times do you expect at least three dice to show a five or six.



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**30.** Assuming that half the population are consumers of chocolate, so that the chance of an individual being a consumer is  $1/2$ , and assuming that 100 investigators each take ten individuals to see whether they are consumers, how many investigators would you

expect to report that 3 people or less were consumers?



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**31.** The probability of a man hitting a target is  $\frac{1}{2}$ . How many times must he fire so that the probability of hitting the target at least once is more than 90 %.



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**32.** An unbiased coin is tossed 8 times. Find ,  
by using binomial distribution, the probability  
of getting at least 6 heads.



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**33.** The items produced by a company contain  
10% defective items. Show that the proximity  
of getting 2 defective items in a sample of 8  
items is  $\frac{28 \times 9^6}{10^8}$  .



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**34.** 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) at least one will fuse after 150 days of use.



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**35.** A die is thrown three times. Let  $X$  be the number of twos seen. Find the expectation of

$X$ .



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**36.** A fair die is tossed twice. If the number appearing on the top is less than 3, it is a success. Find the probability distribution of number of successes.



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**37.** If a random variable  $X$  follows binomial distribution with mean 3 and variance  $3/2$ , find  $P(X \leq 5)$ .



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**38.** If  $X$  follows binomial distribution with mean 4 and variance 2, find  $P(|X - 4| \leq 2)$ .



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**39.** Mean and Variance of a binomial variance are 4 and  $\frac{4}{3}$  respectively then  $P(X \geq 1)$  will be



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**40.** In a binomial distribution the sum and product of the mean and the variance are  $\frac{25}{3}$  and  $\frac{50}{3}$  respectively. Find the distribution.



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**41.** A coin is tossed 5 times. What is the probability of getting at least 3 heads.



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**42.** A man takes a step forward with probability 0.4 and backward with probability 0.6. Find the probability that at the end of 5 steps, he is one step away from the starting point.



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**43.** 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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**44.** 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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**45.** A lot of 100 watches is known to have 10 defective watches. If 8 watches are selected (one by one with replacement) at random, what is the probability that there will be at least one defective watch?



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**46.** For 6 trials of an experiment, let  $X$  be a binomial variate which satisfies the relation

$9P(X = 4) = P(X = 2)$ . Find the probability of success.



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**47.** Find the probability distribution of the number of heads when three coins are tossed.



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**48.** Find the probability distribution of the number of doublets in four throws of a pair of

dice. Also find the mean and variance of this distribution.



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**49.** There are 6% defective items in a large bulk of item. Find the probability that sample of 8 items will include not more than one defective items.



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**50.** A coin is tossed 5 times. What is the probability of getting at least 3 heads.



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**51.** A coin is tossed 5 times. What is the probability that tail appears an odd number of times?



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**52.** A pair of dice is thrown 6 times. If getting a total of 7 is considered a success, find the probability of at least five successes.



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**53.** A coin is tossed 5 times. What is the probability of getting at least 3 heads.



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**54.** Find the probability of 4 turning up at least once in two tosses of a fair die.



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**55.** A coin is tossed 5 times. What is the probability that head appears an even number of times?



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**56.** The probability of a man hitting a target is 0.25. He shoots 7 times. What is the probability of his hitting at least twice?



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**57.** If getting 5 or 6 in a throw of an unbiased die is a success and the random variable  $X$  denotes the number of successes in six throws of the die, find  $P(X \geq 4)$ .



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**58.** Eight coin are thrown simultaneously. Find the chance of obtaining at least six heads.



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**59.** 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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**60.** A bag contains 7 red, 5 white and 8 black balls. If four balls are drawn one by one with replacement, what is the probability that i. None is white? ii. All are white? iii. Any two are white?



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**61.** A box contains 100 tickets each bearing one of the numbers from 1 to 100. If 5 tickets are

drawn successively with replacement from the box, find the probability that all the tickets bear numbers divisible by 10.



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**62.** 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?



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**63.** 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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**64.** Suppose that 90% of people are right-handed. What is the probability that at most 6 of a random sample of 10 people are right-handed?



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**65.** A bag contains 7 green, 4 white and 5 red balls. If four balls are drawn one by one with replacement, what is the probability that one is red?



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**66.** An urn contains 4 white and 3 red balls. Three balls are drawn at random from the urn

with replacement. Find the probability distribution of the number of red balls.



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**67.** Find the probability distribution of the number of doublets in 4 throws of a pair of dice. Also, find the mean and variance of this distribution.



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**68.** Find the probability distribution of the number of sixes in three tosses of a die.



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**69.** A coin is tossed 5 times. If  $X$  is the number of heads observed, find the probability distribution of  $X$ .



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**70.** A dice is rolled twice. Find the probability distribution of number of successes if : A number greater than 4 is to be considered as success.



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**71.** A man wins a rupee for head and loses a rupee for tail when coin is tossed. Suppose that he tosses once and quits if he wins but tries once more if he loses on the first toss.

Find the probability distribution of the number of rupees the man wins.



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**72.** Five dice are thrown simultaneously. If the occurrence of 3, 4 or 5 in a single die is considered a success, find the probability of at least 3 successes.



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**73.** Suppose that a radio tube inserted into a certain type of set has probability 0.2 of functioning more than 500 hours. If we test 4 tubes at random what is the probability that exactly three of these tubes function for more than 500 hours?



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**74.** The probability that a certain kind of component will survive a given shock test is  $\frac{3}{4}$

. Find the probability that among 5 components tested (i) Exactly 2 will survive (ii)

At most 3 will survive



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**75.** It is known that 60% of mice inoculated with a serum are protected from a certain disease. If 5 mice are inoculated, find the probability that (a) None contract the disease  
(b) More than 3 contract the disease.



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**76.** An experiment succeeds twice as often as it fails. Find the probability that in the next six trials, there will be at least 4 successes.



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**77.** In a hospital, there are 20 kidney dialysis machines and that the chance of any one of them to be out of service during a day is 0.02. Determine the probability that exactly 3

machines will be out of service on the same day.



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**78.** 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 heads, he answers "true"; if it falls tails, he answers "false". Find the probability that he answers at least 12 questions correctly.



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**79.** 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

$P(x_i), x_i = 0, 1, 2, 3, 4, 5, 6$ )



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**80.** Oil 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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**81.** 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) at least once (b) exactly once (c) at least twice?



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



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**83.** 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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**84.** How many times must a man toss a fair coin so that the probability of having at least one head is more than 80%?



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**85.** 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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**86.** 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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**87.** Find the expectation of the number of heads in 15 tosses of a coin.



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**88.** Can the mean of a binomial distribution be less than its variance?



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**89.** Determine the binomial distribution whose mean is 9 and variance  $\frac{9}{4}$ .



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**90.** If the mean and variance of a binomial distribution are respectively 9 and 6, find the distribution.



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**91.** If the sum of the mean and variance of a binomial distribution for 5 trials is 1.8; find the distribution.



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**92.** Determine the binomial distribution whose mean is 20 and variance 16.



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**93.** The mean of a binomial distribution is 20, and the standard deviation 4. Calculate parameters of the binomial distribution.



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**94.** If the probability of a defective bolt is 0.1, find the i. mean and ii. standard deviation for the distribution of bolts in a total of 400 bolts.



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**95.** If on an average 9 ships out of 10 arrive safely to ports, find the mean and S.D. of ships returning safely out of a total of 500 ships.



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**96.** In eight throws of a die 5 or 6 is considered a success, find the mean number of successes and the standard deviation.



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**97.** Find the expected number of boys in a family with 8 children, assuming the sex distribution to be equally probable.



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**98.** A die is thrown thrice. A success is 1 or 6 in a throw. Find the mean and variance of the number of successes.



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**99.** If pair of dice is thrown 4 times. If getting a doublet is considered a success, find the probability distribution of the number of successes and hence find its mean.



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**100.** From a lot of 15 bulbs which include 5 defective, a sample of 4 bulbs is drawn one by one with replacement. Find the probability distribution of number of defective bulbs. Hence, find the mean of the distribution.



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**101.** Three cards are drawn successively with replacement from a well shuffled pack of 52 cards. Find the probability distribute of the

number of spades. Hence, find the mean of the distribution.



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**102.** In a binomial distribution, if  $n = 20$ ,  $q = 0.75$ , then write its mean.



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**103.** If in a binomial distribution mean is 5 and variance is 4, write the number of trials.



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**104.** In a group of 200 items, if the probability of getting a defective item is 0.2, write the mean of the distribution.



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**105.** If the mean of a binomial distribution is 20 and its standard deviation is 4, find  $p$ .



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**106.** The mean of a binomial distribution is 10 and its standard deviation is 2, write the value of  $q$ .



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**107.** The mean and variance of a random variable  $X$  having a binomial distribution are 4 and 2 respectively. The  $P(X = 1)$  is



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**108.** If the mean and variance of a binomial variable  $X$  are 2 and 1 respectively. Find  $P(X \geq 1)$ .



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**109.** If in a binomial distribution  $n = 4$  and  $P(X = 0) = \frac{16}{81}$ , find  $q$ .



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**110.** Find the binomial distribution for which the mean is 4 and variance 3.



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**111.** If for a binomial distribution  $P(X = 1) = P(X = 2) = \alpha$ , write  $P(X = 4)$  in terms of  $\alpha$ .



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**112.** A fair coin is tossed four times. Let  $X$  denote the number of heads occurring. Find the probability distribution, mean and variance of  $X$ .



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**113.** If  $X$  follows binomial distribution with parameters

$n = 5$ ,  $p$  and  $P(X = 2) = 9 P(X = 3)$ , then

find the value of  $p$ .





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**114.** 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)  $\frac{9}{10}$



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**115.** If in a binomial distribution

$n = 4$ ,  $P(X = 0) = \frac{16}{81}$ , then  $P(X = 4)$

equals a.  $\frac{1}{16}$  b.  $\frac{1}{81}$  c.  $\frac{1}{27}$  d.  $\frac{1}{8}$



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**116.** A rifleman is firing at a distance target and hence has only 10% chance of hitting it. Find the number of rounds; he must fire in order to have more than 50% chance of hitting it at least once.



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**117.** A fair coin is tossed a fixed number of times. If the probability of getting seven heads is equal to that of getting nine heads, the probability of getting two heads is a.  $\frac{15}{2^8}$  b.  $\frac{2}{15}$  c.  $\frac{15}{2^{13}}$  d. none of these



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**118.** A fair coin is tossed 100 times. The probability of getting tails an odd number of times is a.  $1/2$  b.  $1/8$  c.  $3/8$  d. none of these





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**119.** A fair die is thrown 20 times. The probability that on the 10th throw, the fourth six appears is a.  ${}^{20}C_{10} \times 5^6 / 6^{20}$  b.  $120 \times 5^7 / 6^{10}$  c.  $84 \times 5^6 / 6^{10}$  d. none of these



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**120.** Suppose a random variable X follows the binomial distribution with parameters n and p,

where  $0 < p < 1$  if  $P \frac{X = r}{P(X = n - r)}$  is

independent of  $n$  and  $r$ , then  $p$  equals



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**121.** Let  $X$  denote the number of times heads occur in  $n$  tosses of a fair coin. If  $P(X = 4)$ ,  $P(X = 5)$  and  $P(X = 6)$  are in AP; the value of  $n$  is a. 7, 14 b. 10, 14 c. 12, 7 d. 14, 12



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**122.** One hundred identical coins, each with probability  $p$ , of showing up heads are tossed once. If  $0 < p < 1$  and the probability of heads showing on 50 coins is equal to that 51 coins, then value of  $p$  is, (A)  $\frac{1}{2}$  (B)  $\frac{49}{101}$  (C)  $\frac{50}{101}$  (D)  $\frac{51}{101}$



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**123.** A fair coin is tossed 99 times. If  $X$  is the number of times heads occur, then  $P(X = r)$

is maximum when  $r$  is a. 49, 50 b. 50, 51 c. 51, 52 d. none of these



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**124.** How many times must a man toss a fair coin so that the probability of having at least one head is more than 80%?



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**125.** If the mean and variance of a binomial variable  $X$  are 2 and 1 respectively. Find  $P(X > 1)$ .



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**126.** A biased coin with probability  $p$ ,  $0 < p < 1$  of heads is tossed until a head appears for the first time. If the probability that the number of tosses required is even is  $2/5$ , then  $p$  equals





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**127.** If  $X$  follows binomial distribution with mean 4 and variance 2, find  $P(|X - 4| \leq 2)$ .



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**128.** If  $X$  follows a binomial distribution with parameters  $n = 100$  and  $p = \frac{1}{3}$ , then

$P(X = r)$  is maximum when



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**129.** A fair die is tossed eight times. The probability that a third six is observed in eight

throw is a.  $\frac{{}^7C_2 \times 5^5}{6^7}$  b.  $\frac{{}^7C_2 \times 5^5}{6^8}$  c.  $\frac{{}^7C_2 \times 5^5}{6^6}$  d. none of these



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**130.** Fifteen coupons are numbered 1, 2, 3, ...15 respectively. Seven coupons are selected at random one at a time with replacement The Probability that the largest

number appearing on a selected coupon is 9 is

:



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**131.** A five-digit number is written down at random. The probability that the number is divisible by 5 and no two consecutive digits

are identical is a.  $\frac{1}{5}$  b.  $\frac{1}{5} \left( \frac{9}{10} \right)^3$  c.  $\left( \frac{3}{5} \right)^4$  d.

none of these



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**132.** 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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**133.** The mean and variance of a binomial distribution are 4 and 3 respectively, then the probability of getting exactly six successes in this distribution, is a.  ${}^{16}C_6 \left(\frac{1}{4}\right)^{10} \left(\frac{3}{4}\right)^6$  b.

$${}^{16}C_6 \left(\frac{1}{4}\right)^6 \left(\frac{3}{4}\right)^{10} \quad \text{c.} \quad {}^{12}C_6 \left(\frac{1}{20}\right) \left(\frac{3}{4}\right)^6 \quad \text{d.}$$
$${}^{12}C_6 \left(\frac{1}{4}\right)^6 \left(\frac{3}{4}\right)^6$$



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**134.** A coin is tossed 4 times. The probability that at least one head turns up, is a.  $\frac{1}{16}$  b.  $\frac{2}{16}$   
c.  $\frac{14}{16}$  d.  $\frac{15}{16}$



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**135.** A coin is tossed  $n$  times. The probability of getting head at least once is greater than 0.8.

Then the least value of  $n$  is



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**136.** The probability of selecting a male or a female is same. If the probability that in an office of  $n$  person  $(n - 1)$  males being selected is  $\frac{3}{2^{10}}$ , the value of  $n$  is a. 5 b. 3 c. 10 d. 12





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**137.** A box contains 100 pens of which 10 are defective. What is the probability that out of a sample of 5 pens drawn one by one with replacement at most one is defective? a.

$\left(\frac{9}{10}\right)^5$    b.  $\frac{1}{2}\left(\frac{9}{10}\right)^4$    c.  $\frac{1}{2}\left(\frac{9}{10}\right)^5$    d.

$\left(\frac{9}{10}\right)^5 + \frac{1}{2}\left(\frac{9}{10}\right)^4$



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**138.** Suppose a random variable  $X$  follows the binomial distribution with parameters  $n$  and  $p$ , where  $0 < p < 1$



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**139.** If the probability that a person is not a swimmer is 0.3, then find the probability that out of 5 persons 4 are swimmer



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**140.** Which one is not a requirement of a binomial distribution? a. There are 2 outcomes for each trial b. There is a fixed number of trials c. The outcomes must be dependent on each other d. The probability of successes must be the same for all the trials.



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**141.** What is the probability of guessing correctly at least 8 out of 10 answer on true-false examination?



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## Others

1. Assume that on an average  $n$  telephone number out of 15 called between 2 P. M. and 3 P. M. on week days is busy. What is the probability that if six random selected telephone numbers are called, at least 3 of them will be?



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2. A factory produces bulbs. The probability that one bulb is defective is  $\frac{1}{50}$  and they are packed in boxes of 10. From a single box, find the probability that none of the bulbs is defective exactly two bulbs are defective more than 8 bulbs work properly.



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3. To probability is 0.02 that an item produced by a factory is defective. A shipment of 10,000

items is sent to its warehouse. Find the expected number of defective items and the standard deviation.



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4. A card is drawn and replaced in an ordinary pack of 52 cards. How many times must a card be drawn so that (i) there is at least an even chance of drawing a heart. (ii) the probability of drawing a heart is greater than  $\frac{3}{4}$ ?



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5. The mathematics department has 8 graduate assistants who are assigned to the same office. Each assistant is just likely to study at home as in the office. How many desks must there be in the office so that each assistant has a desk at least 90% of the time?



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