MATHEMATICS

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AIM POINTS
MATHEMATICS
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XIth, XIIth, TARGET IIT-JEE (MAIN + ADVANCE) & COMPETITIVE EXAM. FOR XII (PQRS)

BINOMIAL DISTRIBUTION

& Their Properties

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THINGS TO REMEMBER

1. A random variable X whic takes values 0, 1, 2, ..., n is said to follow binomial distribution if probability function is given by

   $p(X = r) = {}^nC_r\, p^r\, q^{n-r}$, r = 0, 1, 2, ..., n,

   where p, q > 0 such that p + q = 1

   The two constants n and p in the distribution are known as the parameters of the distribution.

   follows binomial distribution with parameters n and p.

   We have,

   $p(X = 0) + p(X = 1) + ... + P(X=n)$

   $= {}^nC_o\, p^o\, q^{n-o} + {}^nC_r\, p^1\, q^{n-1} + ... + {}^nC_n\, p^n\, q^{n-n}$

   $= (q + p)^n = 1^n = 1$

   Thus, the assignment of probabilites ot the radom variable X is permissible.

2. If n trials constitute an experiment and the experiment is repeated N times, then the frequences of 0, 1, 2, ..., n successes are given by

   N. P (X= 0), N. P (X=1), N. P (X = 2), ..., N. P (X = n).

3. The mean and variance of a binomial variate with parameters n and P are np and npq respectively.

4. If (n + 1) P is not an integer :

   P (X = 0), P(X = 1), ..., P (X = n).

   (i) Then, P (X = r) is maximum when r = m [(n + 1) p].

   (ii) If (n + 1) p is an integer, then

   P (X = r) is maximum when r = m – 1 or r= m, where m = (n + 1) p is an integer.

EXERCISE – 1

1. A pair of dice is thrown 7 times. if getting a total of 7 is considered a succes, what is the probability of

   (i) no success. (ii) 6 sucesses ? (iii) at least 6 succeses ? (iv) at most 6 successes ?

2. An unbiased die is thrown again and again until three sixes are obtained. Find the probability of obtaining 3rd is in the sixth throw of the die.

3. Find the probability distribution of the number of doublets in 4 throuws of a pair of dice.

4. Find the probability distribution of the number os sixes in three tosses of a die.

5. An unbiased coin is tossed 5 times. Find, by using binomial distribution, the probability of getting at least 6 heads.

6. six coins are tossed simultaneously. Find the probability of getting.

   (i) 3 heads (ii) no heads (iii) at least one head

7. The probability that a certain kind of component will survvive a given shock test is $\frac{3}{4}$. Find the probability that among 5 components lested

   (i) exactly 2 will survive (ii) at most 3 will survive

8. 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) none contract the disease (ii) more that 3 contract the disease.
9. An experiment succeeds twice as often as it fails. Find the probability that in the next 6 trials there will be at least 4 successes.
10. In a hospital, there are 20 kindney 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 exaclly 3 machines eill be out of service on the same day.
11. The probability that student entering a 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.
12. In a 20question true-false examination suppose a student tosses a fair coin to determine his answer to each question. If the coin falls heads, he answer 'ture', If it falls tails, he answer 'false'. Find the probability that he answers at least 12 questions correctly.
13. Suppose X has binomial distribution with $n = 6$ and $p = \frac{1}{2}$. Show that $X = 3$ is the most likely outcome.
14. In a multiple choice examintion with three possible answer for each of the five questions out of which only one is correct, what is the probability that a candidate would get four or more correct answers just by guessing ?
15. A persion buys a lottery ticket is 50 lotteries, in each of which his chance of qinning a prize is $\frac{1}{100}$. What is the probability that he will win a prize.
    (i) at least once (ii) exacfly once (iii) at least twice ?
16. The probability of a shooter hitting a target in $\frac{3}{4}$. How many minimum number of times must he/she fire is that the probability of hittine the target at least once is more that 0.99 ?
17. How many times must a man toss a fair coin so that the probability of having at least one head is more that 90% .
18. Suppose that 90% of people are righthanded. What is the probability that at most 6 of a random smaple of 10 people are right handed ?
19. If the sum of the mean and variance of a binomial distribution for 5 trials is 1.8, find the distribution.
20. The sum of mean variance of a binomial distribution is 15 and th sum of their squares is 117. Determine the distribution.
21. A perfect cubic die is thrown a large number of times in seats of 8. the occurrence of 5 or 6 is called a success. In what proportion of the sets would you expect 3 successes.

22. Can the means of a binomial distribution be less that its variance ?
23. Determinine the binomial distribution whose mean is 20 and variance 16.
24. The mean of a binomial distribution is 20, and the standard deviation 4. Calculate parametes of the vinomial distribution.
25. If the probability of a defective bolt is 0.1, find the (mean, (ii) standard deviation, for the distribution of bollts in a total of 400 bilts.
26. The mean and variance of a binomial variate with parameters n and p are 16 and 8 respectively. find p (X = 0), P (X = 1), and P (X ≥ 2).
27. The probavility is 0.02 that an item produced by a factory is defective. Ashipment of 10,000 items is sent to its warehouse. Find the expected nukber of defective items and the standard deviation.
28. If a randon variable X follows vinomial distribution with mean 3 and variance $\frac{3}{2}$, find P (X ≤ 5).
29. If X follows binomial distribution with mean 4 nad variance 2 find p (X ≥ 5).
30. The mean and variance of a binomial distribution are $\frac{3}{4}$ and $\frac{8}{9}$ respecitively. Find p (X ≥ 1).
31. If the sum of the mean and variance of a binomail distribution for 6 trials is $\frac{10}{3}$, find the distribution.