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TECHNOLOGY, RESEARCH, SOCIAL INNOVATION & PARTNERSHIPS

SY B.Tech-CSE

Question Bank Unit IV

1 BINOMIAL DISTRIBUTION:-

1. If 10% of bolts produced by a machine are defective. Determine the probability that out of 10 bolts, chosen at random

- (a) 1
- (b) none
- (c) at most 2 bolts will be defective.

Ans: (a) 0.3874 (b) 0.3487 (c) 0.9298

2. An underground mine has 5 pumps installed for pumping out storm water. The probability of any one of the pumps failing during the storm is $\frac{1}{8}$. What is the probability that

- (a) at least 2 pumps will be working
- (b) all the pumps will be working during a particular storm?

Ans: (a) 0.998 (b) 0.5129

3. The probability of entering student in Chartered Accountant will be graduate 0.5. Determine the probability that out of 10 students

- (a) none
- (b) one or
- (c) at least one will graduate.

Ans: (a) 9.765×10^{-4} (b) 9.765×10^{-3} (c) 0.99

4. If mean and variance of binomial distribution are 4 and 2 respectively. Find the probability of

- (a) exactly 2 successes
- (b) less than 2 successes
- (c) at least 2 successes.

Ans: (a) 0.1093 (b) 0.0351 (c) 0.964

5. If 20% of the bolts produced by a machine are defective, determine the probability that out of 4 bolts chosen at random

- (a) 1
- (b) 0
- (c) at most 2 bolts will be defective.

Ans: (a) 0.4096 (b) 0.4096 (c) 0.9728

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

Ans: 233

7. Find the probability of getting a total of 7 at least once in 4 tosses of a pair of fair dice?

Ans: $\frac{671}{1296}$

8. If the chance that any one of the 10 telephone lines is busy at any instant is 0.2. What is the chance that 5 of the lines are busy? What is the probability that all the lines are busy?

Ans: 0.0264, $(0.2)^{10}$

9. An insurance salesman sells policies to 5 men, all of identical age in good health. According to the actuarial tables the probability that a man of this particular age will be alive 30 years hence is $\frac{2}{3}$. Find the probability that in 30 years

- (a) all 5 men
- (b) at least 3 men
- (c) only 2 men
- (d) at least 1 man will be alive.

Ans: (a) $\frac{32}{243}$ (b) $\frac{192}{243}$ (c) $\frac{40}{243}$ (d) $\frac{242}{243}$

10. A box contains 10 screws, 3 of which are defective. Two screws are drawn at random without replacement. Find the probability that none of the two screws is defective.

Ans: $\frac{7}{15}$

11. Out of 800 families with four children each, how many families would be expected to have

- (a) 2 boys and 2 girls
- (b) at least one boy

- (c) no girl
(d) at most two girls?

Assume equal probabilities for boys and girls. **Ans:**
(a) 300 (b) 750 (c) 50 (d) 550

12. An electronic component consists of three parts. Each part has probability 0.99 of performing satisfactorily. The component fails if 2 or more parts do not perform satisfactorily. Assuming that the parts perform independently, determine the probability that the component does not perform satisfactorily.

Ans: 0.000298

13. The incidence of occupational disease in an industry is such that the workers have 20% chance of suffering from it. What is the probability that out of 6 workers 4 or more will catch the disease?

Ans: $\frac{53}{2125}$

14. Fit a Binomial distribution to the following data.

x	0	1	2	3	4	5
f	2	22	63	76	96	56

Ans: $315(0.34 + 0.66)^5$

2 POISSON DISTRIBUTION:-

1. The number of arrivals of customers during any day follows Poisson distribution with a mean of 5. What is the probability that the total number of customers on two days selected at random is less than 2?

Ans: $4.994 * 10^{-4}$

2. In a certain factory producing cycle tyres, there is a small chance of 1 in 500 tyres to be defective. The tyres are supplied in lots of 10. Using Poisson distribution, calculate the approximate number of lots containing no defective, one defective and two defective tyres, respectively, in a consignment of 10,000 lots.

Ans:

- (a) $P(0)=0.9802$, 9802 lots
- (b) $P(1)=0.019604$, 196 lots
- (c) $P(2)=0.00019604$, 2 lots

3. If the probability that an individual suffers a bad reaction from a certain infection is 0.001. Determine the probability that out of 2000 individuals

- (a) exactly 3
- (b) more than 2 individuals
- (c) none
- (d) more than one individual will suffer a bad reaction.

Ans: i. 0.18 ii. 0.325 iii. 0.135 iv. 0.595

4. An insurance company found that only 0.01% of the population is involved in a certain type of accident each year. If its 1000 policy holders were randomly selected from the population, what is the probability that not more than two of its clients are involved in such an accident next year? (given $e^{-0.1} = 0.9048$)

Ans: 0.9998

5. Find the probability that at most 5 defective fuses will be found in a box of 200 fuses if experience shows that 2% of such fuses are defective.

Ans: 0.785

6. The number of accidents during a year in a factory has the Poisson distribution with mean 1.5. The accidents during different years are assumed independent. Find the probability that only 2 accidents take place during 2 years time.

Ans: 0.224

7. A manufacturer of cotter pins knows that 5% of his product is defective. If he sells cotter pins in boxes of 100 and guarantee that not more than 10 pins will be defective. What is the approximate probability that a box will fail to meet the guaranteed quality. [$e^{-5} = 0.006738$]

Ans: 0.0136875

8. Suppose the number of telephone calls on an operator received from 9.00 to 9.05 follows a Poisson distribution with mean 3. Find the probability that

(a) the operator will receive no calls in that time interval tomorrow

(b) in the next three days the operator will receive a total of 1 call in that time interval. [$e^{-3} = 0.04978$]

Ans: (a) e^{-3} (b) $3 * (e^{-3})^2 * e^{-3} * 3$

9. The distribution of typing mistakes committed by a typist is given below. Assuming a Poisson model,

find out the expected frequencies.

Mistakes per pages	0	1	2	3	4	5
No. of pages	142	156	69	27	5	1

Ans: 147, 147, 74, 25, 6, 1 pages

10. Wireless sets are manufactured with 25 soldered joints each. On the average, 1 joint in 500 is defective. How many sets can be expected to be free from defective joints in a consignment of 10000 sets?

Ans: 9512

11. In certain factory turning out razor blades, there is a small chance $\frac{1}{500}$ for any blade to be defective. The blades are supplied in packet of 10. Using Poisson's distribution, calculate the approximate number of packets containing

- (a) no defective
- (b) one defective
- (c) two defective blades

12. A certain screw making machine produces an average 2 defective screws out of 100 and pack them in boxes of 500. Find the probability that a box contains 15 defective screws.

Ans: 0.0347

13. The distribution of the number of road accidents per day in a city is Poisson with mean 4. Find the number of days out of 100 days when there will be

- (a) no accident
- (b) at least 2 accidents

- (c) at most 3 accidents
- (d) between 2 and 5 accidents

Ans: (a) 2 days (b) 91 days (c) 43 days (d) 39 days

14. Fit a Poisson distribution to the following frequency distribution and compare the theoretical frequencies with observed frequencies.

x	0	1	2	3	4	5
f	158	160	60	25	10	2

15. A source of liquid is known to contain bacteria with the mean number of bacteria per cubic centimeter equal to 2. Five 1 c.c. test tubes are filled with the liquid, assuming that Poisson distribution is applicable, calculate the probability that all test tubes show growth.

Ans: 0.036

3 NORMAL DISTRIBUTION:-

1. Find the area under the normal curve in each of the cases:
 - (a) $z=0$ and $z=1.2$
 - (b) $z= -0.68$ and $z=0$
 - (c) $z= -0.46$ and $z=2.21$
 - (d) $z=0.81$ and $z=1.94$
 - (e) To the left of $z=0.6$
 - (f) Right of $z= -1.28$

Ans: (a) 0.3849 (b) 0.2518 (c) 0.6637 (d) 0.1828 (e) 0.2743 (f) 0.8997

2. Assume mean height of soldiers to be 68.22 inches with a variance of 10.8 inches square. How many soldiers in a regiment of 1000 would you expect to be over 6 feet tall, given that the area under the standard normal curve between $x=0$ and $x=0.35$ is 0.1368 and between $x=0$ and $x=1.15$ is 0.3746.

Ans: 99%

3. A sample of 100 dry battery cells tested to find the length of life produced the following results:

$$\bar{x} = 12 \text{ hours}, \quad \sigma = 3 \text{ hours}$$

Assuming the data to be normally distributed, what percentage of battery cells are expected to have life

- (a) more than 15 hours
- (b) less than 6 hours
- (c) between 10 and 14 hours ?

Ans: (a) 15.87% (b) 2.28% (c) 49.70%

4. The mean yield per plot of a crop is 17 kg and standard deviation is 3 kg. If distribution of yield per plot is normal. Find the percentage of plots giving yields

- (a) between 15.5 kg and 20 kg
- (b) more than 20 kg

Ans: (a) 53.28% (b) 0.1587

5. In a sample of 1000 cases, the mean of a certain test is 14 and standard deviation is 2.5. Assuming the distribution to be normal, find

(a) how many students score between 12 and 15 ?

(b) how many score above 18 ?

(c) how many score below 8 ?

(d) how many score 16 ?

(Given: area between -0.8 to $0.4 = 0.4435$, area right to $1.6 = 0.0548$, area left to $-2.4 = 0.0082$, area between 0.6 and $1 = 0.1156$)

Ans: (a) 444 (b) 55 (c) 8 (d) 116

6. The mean inside diameter of a sample of 200 washers produced by a machine is 0.502 cm and the standard deviation is 0.005 cm. The purpose for which these washers are intended allows a maximum tolerance in the diameter of 0.496 to 0.508 cm, otherwise the washers are considered defective. Determine the percentage of defective washers produced by the machine, assuming the diameters are normally distributed.

(Given: area between $z = -1.2$ and $z = 1.2$ is 0.7698)

Ans: 23.02%

7. A manufacturer of envelopes knows that the weight of the envelopes is normally distributed with mean 1.9 gm and variance 0.01 gm. Find how many envelopes weighing

(a) 2 gm or more

(b) 2.1 gm or more, can be expected in a given packet of 1000 envelopes.

(Given: if t is the normal variable, then $\phi(0 \leq t \leq 1) = 0.3413$ and $\phi(0 \leq t \leq 2) = 0.4772$, area right to $z=1$ is 0.1587 and area right to $z=2$ is 0.0228)

Ans: (a) 159 (b) 23

8. The life of army shoes is 'normally' distributed with mean 8 months and standard deviation 2 months. If 5000 pairs are issued how many pairs would be expected to need replacement after 12 months?

(Given: $P(z \geq 2) = 0.0228$ and $z = \frac{x-\mu}{\sigma}$)

Ans: 4886 pair of shoes

9. In a male population of 1000, the mean height is 68.16 inches and standard deviation is 3.2 inches. How many men may be more than 6 feet (72 inches)?
(Given: $\phi(1.15) = 0.8749$, $\phi(1.2) = 0.8849$, $\phi(1.25) = 0.8944$)

where the argument is the standard normal variable.

Ans: 115

10. Pipes for tobacco are being packed in fancy plastic boxes. The length of the pipes is normally distributed with $\mu = 5''$ and $\sigma = 0.1''$. The internal length of the boxes is 5.2''. What is the probability that the box would be small for the pipe?

(Given: $\phi(1.8) = 0.9641$, $\phi(2) = 0.9772$, $\phi(2.5) = 0.9938$)

Ans: 0.0228

11. Assuming that the diameters of 1000 brass plugs taken consecutively from a machine form a normal

distribution with mean 0.7515 cm and standard deviation 0.0020 cm. How many of the plugs are likely to be rejected if the approved diameter is 0.752 ± 0.004 cm?
(Given : area under $z = -1.75$ to $z = 2.25$ is 0.9477)

Ans: 52.3

12. A manufacturer knows from experience that the resistance of resistors he produces is normal with mean $\mu = 100$ ohms and standard deviation $\sigma = 2$ ohms. What percentage of resistors will have resistance between 98 ohms and 102 ohms ?

(Given: area between $z = -1$ and $z = 1$ is 0.6826)

Ans: 68.26

13. The lifetime of radio tubes manufactured in a factory is known to have an average value of 10 years. Find the probability that the lifetime of a tube taken randomly

(a) exceeds 15 years

(b) is less than 5 years, assuming that the exponential probability law is followed.

Ans: (a) 0.2231 (b) 0.3935

14. The breaking strength X of a cotton fabric is normally distributed with $E(x) = 16$ and $\sigma(x) = 1$. The fabric is said to be good if $X \geq 14$. What is the probability that a fabric chosen at random is good. (Given: $\phi(2) = 0.9772$)

Ans: 0.9772

15. A manufacturer knows from experience that the resistance of resistors he produces is normal with mean $\mu = 140 \Omega$ and standard deviation $\sigma = 5 \Omega$. Find the percentage of the resistors that will have resistance between

138 Ω and 142 Ω .

(Given: $\phi(0.4) = 0.6554$, where z is the standard normal variate.)

Ans: 31.08%

16. A manufacturing company packs pencils in fancy plastic boxes. The length of the pencils is normally distributed with $\mu = 6''$ and $\sigma = 0.2''$. The internal length of the boxes is 6.4''. What is the probability that the box would be too small for the pencils.

(Given: $\phi(2) = 0.9772$)

Ans: 0.0228

17. A manufacturer produces airmail envelopes, whose weight is normal with mean $\mu = 1.95$ gm and standard deviation $\sigma = 0.05$ gm. The envelopes are sold in lots of 1000. How many envelopes in a lot will be heavier than 2 gm?

(Given: $\frac{1}{\sqrt{2\pi}} \int_2^1 \exp\left(-\frac{x^2}{2}\right) dx = 0.3413$)

Ans: 159

18. The mean height of 500 students is 151 cm and the standard deviation is 15 cm. Assuming that the heights are normally distributed, find how many students height lie between 120 and 155 cm.

Ans: 294

19. A large number of measurement is normally distributed with a mean of 65.5'' and S.D. of 6.2''. Find the percentage of measurements that fall between 54.8'' and 68.8''

Ans: 66.01%

20. X is normally distributed and the mean of X is 15 and standard deviation 3. Determine the probability of

(a) $0 < X < 10$

(b) $X \geq 18$

Ans: (a) 0.10483 (b) 0.1587

21. In a normal distribution, 31% of the items are under 45 and 8% are over 64. Find the mean and standard deviation of distribution.

Ans: $\sigma = 10.0529$, $\mu = 49.9259$

22. A random sample of 200 screws is drawn from a population which represents the size of screws. If a sample is distributed normally with mean 3.15 cm and standard deviation 0.025 cm, find expected number of screws whose size falls between 3.12 cm and 3.2 cm.

(**Given:** area corresponding to 1.2 = 0.3849 and area corresponding to 2.0 = 0.4772)

Note: $p(-1.2 < z < 2) = p(0 < z < 1.2) + p(0 < z < 2)$

Ans: 172 approx.

23. For a normal distribution, $N = 300$, $\mu = 75$ and $\sigma = 15$. How many values lie between $x = 60$ and $x = 70$?

The area under the normal curve for various values of Z is given as,

Z	Area
0.33	0.12930
0.34	0.13307
1	0.34134

Ans: 63 approx.

24. Obtain the equation of normal curve that may be fitted to the following distribution.

x	50	60	70	80	90	100
f	5	20	120	250	240	5

Also obtain expected normal frequencies.

4 MORE QUESTIONS:-

1. 10 coins are thrown simultaneously. Find the probability that

(a) exactly 3 heads will appear

(b) three or less heads will appear

Ans: (a) 0.1172 (b) 0.1718

2. Probability of man now aged 60 years will live upto 70 years of age is 0.65. Find the probability of out of 10 men sixty years old 6 or more will live upto the age of 70 years.

Ans: 0.2377

3. In sampling the large numbers of parts manufactured by a machine, the mean number of defectives in a sample of 20 is 2 out of 1000 such samples. How many would be expected to contain at least 3 defective parts?

Ans: 323

4. According to past record of one day internationals between India and Pakistan, India has won 15 matches

and lost 10. If they decided to play a series of 6 matches now, what is the probability of India winning the series?

(Draw is ruled out)

Ans: 0.5443

5. Two dice are thrown 100 times and the number of nines recorded. What is the probability that "r" nines occur? Find the probability that at least 3 nines occur.

Ans: 0.00045

6. Between 2 p.m. and 3 p.m. the average number of phone calls per minute coming into the company are 2. Find the probability that during one particular minute, there will be

(a) no phone calls at all

(b) 2 or less calls

Ans: (a) 0.1353 (b) 6/65

7. In a Telephone exchange, the probability that any one call is wrongly connected is 0.02. What is the minimum number of calls required to ensure a probability 0.1 that at least one call is wrongly connected?

Ans: 6 approx.

8. A manufacturer of electronic goods has 4% of his product defective. He sells the articles in packets of 300 and guarantees 90 % good quality. Determine the probability that a particular packet will violate the guarantee.

9. In a certain examination, the percentage of passes and distinction were 48 and 10 respectively. Estimate the average marks obtained by the candidates, the minimum pass and distinction marks being 40 and 75 respectively.

Ans: 38.5772

10. 5000 candidates appeared in a certain paper carrying a maximum of 100 marks. It was found that marks were normally distributed with mean 39.5 and standard deviation 12.5. Determine approximately the number of candidates who secured a first class for which a minimum of 60 marks is necessary.

Ans: 253