



## POISSON DISTRIBUTION

Poisson is a limiting case of Binomial distribution when

- $n$  is very large ( $n \rightarrow \infty$ )
- $p$  is very small ( $p \rightarrow 0$ )

$$P(X=r) = \frac{e^{-m} m^r}{r!} \quad \text{where } m = \text{mean} = np$$

Q.1) If a random variable  $r$  has a Poisson Distribution such that:  
 $P(r=1) = P(r=2)$ , then find  $P(r=4)$

- (2) 6 coins are tossed 320 times using Poisson distribution, find the approximate probability of getting 6 heads at most 2 times
- (3) Find the probability that at most 5 defective fuses will be found in a box of 200 fuses if 2% of such fuses are defective.
- (4) In a certain factory turning out razor blades, there is a small chance of  $\frac{1}{500}$

for any blade to be defective. The blades are supplied in packets of 10. Use Poisson Distribution to calculate approximate number of packets containing:

(i) no defective blades

(ii) one defective blade, respectively in the consignment of 1000 packets.

(5) 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?

(6) A car hire firm has two cars which it hires out day by day. The number of demands for a car on each day is distributed as a Poisson distribution with mean 1.5. Calculate the proportion of days on which car is not used & the proportion of days on which

Some demand is refused.

(7) Using Poisson distribution, find the probability that the ace of spades will be drawn from a pack of well-shuffled cards at least once in 104 consecutive trials.

(8) The number of people asking for emergency dental treatment per day at surgery A is a Poisson variate with a mean value of 2.

The number of requests for emergency treatment per day at surgery B is an independent Poisson variate with a mean value of 3. Find the probability that,

(i) both surgeries have exactly two requests for emergency treatment,

(ii) less than two people in total ask for emergency treatment at either or both surgeries.

(iii) find an expression for the probability that both surgeries have the same number of requests of emergency treatment.

(9) A man travels to work by bus. He always arrives at the bus stop at the same time & if he has to wait more than five minutes for a bus, he is late for work. The number of buses arriving at the bus stop is a Poisson variate with a mean of 2 buses every five minutes.

(i) Find the probability that, on any one day, he will be late for work.

(ii) Find the probability that he will be late at work at least once in a five day working week.

(10) A manufacturer of cotter pins knows that 5% of his product is defective. If he sells cotter pins in boxes of 100 & guarantees that not more than 10 pins will be defective, what is the approximate probability that a box will fail to meet the guaranteed quality?



(11) A manufacturer, who produces medicine bottles, finds that 0.1% of the bottles are defective. The bottles are packed in boxes containing 500 bottles. A drug manufacturer buys 100 boxes from the producer of bottles. Using Poisson distribution, find how many boxes will contain:

(i) no defective & (ii) at least two defective.

[Ans: 61; 9]

(12) Six coins are tossed 6,400 times.

Using Poisson distribution, find the approximate probability of getting  $r$  heads  $n$  times.

[Ans:  $\frac{e^{-100} (100)^r}{r!}$ ]

(13) In a book of 520 pages, 390 typo-graphical errors occur. Assuming Poisson law for the number of errors per page, find the probability that a random sample of 5 pages will contain no error. [Ans:  $e^{-3.75}$ ]

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(14) In a Poisson frequency distribution, frequency corresponding to 3 successes is  $\frac{2}{3}$  times frequency corresponding to 4 successes. Find the mean & standard deviation of the distribution. [Ans: 6;  $\sqrt{6}$ ]

(15) A manager accepts the work submitted by his typist only when there is no mistake in the work. The typist has to type on an average 20 letters per day of about 200 words each. Find the chance of her making a mistake: (i) if less than 1% of the letters submitted by her are rejected, (ii) if on 90% days all the letters submitted by her are accepted. [Ans: 0.0000506; 0.0000263]

$$\frac{e^{-m} m^0}{0!} \geq \frac{99}{100}$$

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(16) Fit a Poisson distribution to the following:

$x$	0	1	2	3	4
$f$	192	100	24	3	1

(17) The following is the data of men killed by the kicks of horse in a certain army in twenty years. Calculate the theoretical frequencies taking the distribution to be Poisson.

No. of deaths	0	1	2	3	4
Frequency	109	65	22	3	1

(18) After correcting 50 pages of the proof of a book, the proof reader finds that there are, on the average, 2 errors per 5 pages. How many pages would one expect to find with 0, 1, 2, 3 & 4 errors, in 1000 pages of the first print of the book?