1) State pmf of Poisson Distribution.

A. **Probability mass function**

A discrete random variable *X* is said to have a Poisson distribution, with parameter $\lambda > 0,$ if it has a probability mass function given by

$$f(k; \lambda) = \Pr(X=k) = \frac{\lambda^k e^{-\lambda}}{k!},$$

where

- *k* is the number of occurrences ( )
- *e* is Euler's number ( )
- ! is the factorial function.

2) Let such that E(X)=4 and SD(X) = √3 find n and p.

A. mean=np=4,

Std.dev = (npq)1/2

2*(q)1/2 = (3)1/2

Squaring on both sides

4 (q)=3 , q=1-p

q=3/4 ,then p=1-3/4=1/4

now,we know p

np=4

n*1/4=4

n=16

3) State the additive property of Binomial Distribution

A. Additive property of binomial distribution.

Let X and Y be the two independent binomial variables.

X is having the parameters n_1 and p

and

Y is having the parameters n_2 and p.

Then (X + Y) will also be a binomial variable with the parameters (n_1 + n_2) and p

4) State pmf of multinomial Distribution.

A. The probability mass function of this multinomial distribution is:

$$f(x_1,\ldots,x_k;n,p_1,\ldots,p_k) = \Pr(X_1 = x_1 \text{ and } \ldots \text{ and } X_k = x_k)$$
$$= \begin{cases} \dfrac{n!}{x_1!\cdots x_k!} p_1^{x_1} \times \cdots \times p_k^{x_k}, & \text{when } \sum_{i=1}^k x_i = n \\ \\ 0 & \text{otherwise,} \end{cases}$$

for non-negative integers x_1, ..., x_k.

The probability mass function can be expressed using the gamma function as:

$$f(x_1,\ldots,x_k;p_1,\ldots,p_k) = \frac{\Gamma(\sum_i x_i + 1)}{\prod_i \Gamma(x_i + 1)} \prod_{i=1}^k p_i^{x_i}.$$

6) A coin is tossed 12 times. What is the probability of getting exactly 7 heads?
A. pmf=nCk p^k q^k where n=12 , p=1/2 , q=1/2 and k=7
= 12C7 (1/2)^7 (1/2)^7
= 12*11*2*3*1/2^7*1/2^7
=11*9*1/2^4*1/2^7
=0.0483

8) The mean number of bacteria per millilitre of a liquid is known to be 6. Find the probability that in 1 ml of the liquid, there will be:

(a) 0,

A. pmf= $f(k;\lambda) = \Pr(X{=}k) = \dfrac{\lambda^k e^{-\lambda}}{k!},$

Where λ = 6

P(k=0) = 6^0 e^-6/0!=1/e^6=0.002

(b) 1,

P(k=1) = 6^1*e^-6/1! =6*1/e^6=0.012

(c) 2,

P(k=2) = 6^2*e^-6/2!= 18/e^6=0.036

(d) 3

A. P(k=3) = 6^3*e^-6/3!=36*/e^6=0.072

(e) less than 4,

A. p(k<4) = P(k=0)+ P(k=1)+ P(k=2)+ P(k=3)

= 0.002+0.012+0.036+0.072

=0.122

(f) 6 bacteria.

A. P(k=6)= 6^6*e^-6/6!= 259.2*e^-6= 0.518

10) State the pmf of negative binomial distribution.

A. The probability mass function of the negative binomial distribution is

where *r* is the number of successes, *k* is the number of failures, and *p* is the probability of success on each trial.

$$f(k; r, p) \equiv \Pr(X = k) = \binom{k+r-1}{k} (1-p)^k p^r$$