Theoretical Distribution
Theory Notes

BASICS

- A theoretical probability distribution exists only in theory and in real life.
- Probability distribution may be discrete or continuous.
- Parameter is a characteristic of population.
- Population mean is an example of a parameter.
- A trial is an attempt to produce an outcome which is neither certain nor impossible.
- The cumulative distribution function of a random variable X is given by $f(x) = P(X \leq x)$.
- Probability density function is associated with continuous random variables.
- Probability density function is always greater than equal to 0.
- For continuous random variables probability of the entire space is 1.
- For discrete random variables the probability of the entire space is 1.
- For discrete random variable x, expected value of x(i.e E(x)) is defined as the sum of products of the different values and the corresponding probabilities.
- For a probability distribution, mean is the expected value of x.
- Variance is the expected value of $(x - m)^2$, where m is the mean.
- The expected value of a constant k is the constant k
- The probability distribution whose frequency function $f(x) = 1/n(x = x_1, x_2 \ldots X_n)$ is known as Uniform distribution.
- Theoretical distribution is a probability distribution.
- Probability function is known as frequency function.
- The number of points obtained in a single throw of an unbiased die are Uniform distribution
- In continuous probability distribution $P(x \leq t)$ means area under the probability curve to the left of the vertical line at t.
- In continuous probability distribution F(x) is called cumulative distribution function.

BINOMIAL

- The important characteristic(s) of Bernoulli trials is that each trial is associated with just two possible outcomes and trials are independent.
- The probability mass function of binomial distribution is given by

$$f(x) = {}^{n}c_{x}\, p^{x}\, q^{n-x}.$$

- X can assume any whole number between 0 and n, both inclusive if x is a binomial variable with parameters n and p.
- Symmetrical when p = 0.5 is a binomial distribution.
- np is the mean of a binomial distribution with parameter n and p.
- nq (1 – q) is the variance of a binomial distribution with parameters n and p.
- Binomial distribution is an example of a bi-parametric discrete probability distribution.
- Mean and mode are equal when q = 0.50 for a binomial distribution.
- The mean of binomial distribution is always more than its variance.
- There may be one mode for a binomial distribution.
- n/4 is the maximum value of the variance of a binomial distribution with parameters n and p.
- The method usually applied for fitting a binomial distribution is known as method of moments.
- A binomial distribution with parameters n and p can be approximated by a Poisson distribution with parameter m = np is n →∞ and p → 0 so that np remains finite.
- Binomial distribution follows the results of ODI matches between India and Pakistan.
- Symmetrical is the binomial distribution, when p = 0.5
- When 'p' is larger than 0.5, the binomial distribution is asymmetrical.
- np is the mean of binomial distribution.
- npq is variance of binomial distribution.
- When p = 0.1 the binomial distribution is skewed to the right.
- In Binomial distribution 'n' mean number of trials of the experiment.
- Discrete is a Binomial probability distribution.
- When there are a fixed number of repeated trial of any experiments under identical conditions for which only one of two mutually exclusive outcomes, success or failure can result in each trial then, we use Binomial distribution.
- In Binomial distribution 'p' denotes probability of success.
- If p = q binomial distribution is symmetrical.
- In binomial distribution if n is infinitely large, the probability p of occurrence of event is close to 0 and q is close to 1.
- If neither p nor q is very small but n sufficiently large, the binomial distribution is very closely approximated by normal distribution.
- For n independent trials in Binomial distribution the sum of the powers of p and q is always n, whatever be the no. of success
- In binomial distribution parameters are n and p.
- If n = 4 and p = 1/3 then the value of variance is 8/9 in Binomial distribution.
- If mean = 20, S.D = 4 then q is equal to 4/5 in Binomial distribution.
- If in a Binomial distribution mean = 20, S.D = 4 then p is equal to 1/5.
- If is a Binomial distribution mean = 20, S.D = 4 then n is equal to 100.
- The probability that x assumes a specified value in continuous probability distribution is 0.
- If in Binomial distribution np = 9 and npq = 2.25 then q is equal to 0.25.
- Mean is greater than variance in Binomial distribution.
- Standard deviation of binomial distribution is $\sqrt{npq}$.
- In Binomial distribution standard deviation is equal to $\sqrt{npq}$.

POISSION

- Poisson distribution is an important discrete probability distribution.
- Poisson model is not the probability of having success in a small time interval is constant.
- Poisson is uniparametric distriburtion.
- Mean and variance are equal, for a Poisson distribution.
- Poisson distribution may be unimodal or bimodal.
- Poisson distribution is always positively skewed.
- We equate the Poisson parameter to the mean of the frequency distribution, for Poisson fitting to an observed frequency distribution.
- Poisson distribution follows the number of misprints per page of a thick book.
- Poisson distribution is a limiting case of Binomial distribution.
- Poisson distribution is use when the number of trials is large and probability of success is small.
- Probability of success is very close to 0 in Poisson distribution.
- In Poisson distribution np is finite.
- In Poisson distribution, mean = variance.
- In Poisson distribution mean is equal to (λ).
- If the mean value is high the Poisson distribution tends to be symmetrical.
- Poisson distribution approaches a normal distribution as n increase infinitely.
- Poisson distribution is a discrete probability distribution.
- Poisson distribution is an example of number of radio-active atoms decaying in a given interval.
- Poisson distribution is sometimes known as the “distribution of rare events”.

NORMAL

- Normal distribution is an important continuous probability distribution.
- The most important continuous probability distribution is known as Normal distribution.
- The probability density function of a normal variable x is given by $f(x) = \frac{1}{\sigma\sqrt{2\pi}} . e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$ for $-\infty < x < \infty$.
- The total area of the normal curve is one.
- Bell-shaped is the normal curve.
- Symmetrical is the normal curve.
- The normal curve area between $-\infty$ to μ is 0.50 and μ *to* ∞ is 0.50.
- The mean and mode of a normal distribution are always equal.
- 0.80 is the mean deviation about median of a standard normal variate.

- The quartile deviation of a normal distribution with mean 10 and SD 4 is 2.70.
- For a standard normal distribution, the points of inflexion are given by -1 and 1.
- The standard normal curve between $-\propto$ to a indicates the symbol ϕ (a).
- The interval $(\mu - 3\sigma, \mu + 3\sigma)$ covers all but 0.27% area of a normal distribution.
- Normal distribution follow the wage of workers of a factory.
- If X and Y are two independent normal random variables, then the distribution of (X + Y) is normal.
- We use binomial distribution when a coin tossed 10 times.
- For continuous events normal distribution is used.
- The curve of normal distribution has single peak.
- The curve of normal distribution is unimodal and bell shaped with the highest point over the mean.
- Because of the symmetry of Normal distribution the median and the mode have the same value as that of the mean.
- The total area under the normal curve is 1 for a normal distribution.
- In normal distribution the probability has the maximum value at the mean.
- In normal distribution the probability decreases gradually on either side of the mean but never touches the axis.
- Whatever may be the parameter of normal distribution, it has same shape.
- In standard normal distribution mean $= 0$, SD $= 1$.
- The number of methods for fitting the normal curve is 2.
- Mean, median and mode are equal in normal distribution.
- The quartiles are equidistant from mean in normal distribution.
- In normal distribution as the distance from the mean increases, the curve comes closer and closer to the horizontal axis.

OTHERS

- t distribution is symmetrical around $t = 0$.
- As the degree of freedom increases, the t distribution approaches the standard normal distribution.
- t distribution is asymptotic to the horizontal axis.
- t distribution has a greater spread than Normal distribution curve.